U. S. TREASURY DEPARTMENT
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PUBLIC HEALTH SERVICE
HUGH S. CUMMING, *Surgeon General*

THE RAT PROOFING OF VESSELS

(THIRD EDITION)

With Drawings Illustrating the General Instructions for Rat Proofing of Ships Compiled and Promulgated by the American Marine Standards Committee (H No. 41, Approved February 8, 1929)

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FOREWORD TO THIRD EDITION

The first article on the rat proofing of vessels appeared in Public Health Reports for July 17, 1925. In that article it was proposed that ships could be rat proofed as well as buildings and similar structures. The definition of rat proofing was given, the principles involved and their application to ship construction were set forth, and the experience that had been gained was presented.

This publication aroused a widespread interest, especially among shipbuilders and shipowners, the article was translated subsequently into several languages, and a second and larger edition was soon necessary. This second edition was published in December, 1926, and included the original report and a foreword stating that the progress made and results attained since the first edition was published justified further prosecution of the work.

The second edition has become exhausted, and there is now a demand for a third edition which will bring the subject up to date and completely cover all phases of rat proofing as applied to vessels both new and old. The best method of presenting a subject of such proved interest to all maritime nations is through the combined use of text, drawings, and photographs; and the large number of these make an important addition to this publication.

There are two general index drawings, one showing a typical longitudinal and the other a typical transverse section of a ship. Important key points where rats usually find harborage are indicated by numbers. In addition, there are detail drawings numbered to correspond to the key numbers on the two index drawings. These detail drawings show how each type of rat harborage should be corrected. Similar corresponding numbers also have been inserted appropriately in the general instructions to guide the reader from each item of these instructions to the drawing that illustrates how each instruction is carried out. These instructions, except for the inserted reference numbers, are copied in full from Rat Proofing of Ships, General Instructions, approved February 8, 1929, and issued by the Department of Commerce as American Marine Standard H No. 41–1929.

The specifications for rat proofing previously published in the first and second editions are now revoked in order to avoid confusion and to confine all instructions to those issued as an official marine standard.

THE RAT PROOFING OF VESSELS

By S. B. GRUBBS, *Medical Director*, and B. E. HOLSENDORF, *Chief Pharmacist*, *United States Public Health Service*

Introduction

The prevention of rat life on shipboard is a measure of economy in ship operation as well as a means of improved sanitation, comfort, and safety. The high degree of operating efficiency necessary in the marine industry to insure financial success demands that all possible debit items be eliminated. Rats live at the expense of the ship operator, either directly or indirectly; and to lessen this economic waste incurred through damage of cargo or stores there are professional rat catchers and fumigators in many ports who are employed regularly on the ships. The sums thus paid must be considerable. In addition, based upon the assumption that all ships ordinarily harbor rats and the fact that such rats are potential carriers of bubonic plague, routine fumigation in some form for rat destruction is required by sanitary authorities at nearly all the ports of the world, which results in expense and loss of time to the ships as well as interference with schedule.

The History of Rat Life on Vessels and Its Relation to Structural and Other Conditions

The presence of rats on ships has always been taken for granted. The old proverb, "Rats leave a sinking ship," was intended to convey the idea that all ships had a rat population which remained on board until, in some mysterious way, they were warned that danger threatened. Experience gained in dealing with ships in a quarantine way has shown that the majority of vessels are, or have been at some time, rat infested. For years, apparently, no one seemed to be sufficiently interested to determine the cause of this permanent existence of rat life on shipboard. It was generally known and accepted that rats lived aboard ships, that they were great travelers, and that they spread wherever commerce had gone. There are records in almost every quarantine office of hundreds of vessels that are known (some internationally) to have been rat infested for years despite all attempts by fumigation and otherwise to free them of rodent life.

Every old seafaring man could tell dozens of interesting stories of his observation of the presence of rats on ships and of his experience in trying to get rid of them.

There are many instances of ships that have remained rat infested for periods of from 10 to 20 years, but only a few outstanding cases of recent times will be cited as typical of the various classes of vessels.

Two 3,000-ton West Indian liners that were built in 1899, and which are still in service after 30 years, were known to be badly rat infested in 1912 at the time of the outbreak of bubonic plague in San Juan. The knowledge of their infestation and its extent was obtained through inspections incident to fumigations. In 1926 and 1927, these vessels were still badly rat infested, although they had been fumigated every six months; as a matter of fact the rat population on one had increased during this 14-year period, as shown by a yield of more than 400 rats in one fumigation in 1925.

Two large passenger and freight steamers trading to South American ports had bad rat histories for years, the yield of rodents from fumigation and trapping being very high each trip. This condition persisted for at least 10 years, notwithstanding regularly repeated fumigation.

A large steamer engaged in freight and passenger trade between New York and the Pacific coast yielded a large number of rats at the time of each fumigation, and, as a result, trapping was carried on by the company almost constantly for many years; yet after a period of more than 12 years, and despite the fact that the vessel was partially rebuilt and reconditioned, considerable evidence of rat life continued to be found on board this ship.

A freighter engaged in the Australian and Indian trade has for more than five years shown an increasing number of rats on board at each fumigation period.

Several of the round-the-world combination freight and passenger vessels have histories of constant rat life on board for almost seven years.

A similar condition existed until two or three years ago on a number of the largest liners engaged in passenger trade on the North Atlantic.

The generally accepted theory is that most rats come on board in rat-attractive or rat-harboring cargoes, and also via gangways, cargo skids, hawsers, etc. It is probably true that some rats do gain access in this manner, but many vessels become originally infested during construction.

A recent report of a special survey that had been made on 48 new ships showed that 29 of them had become rat infested in the ship-

yards during their construction. Included in this number were 6 vessels built in Italy, 3 in Great Britain, 3 in Germany, 2 in France, 3 in Spain, 2 in Holland, and 10 in the United States.

The data thus collected over a period of almost four years tend to show very conclusively that a large number of vessels become infested with rats in the shipyards while being constructed and that many of them continue to harbor rats for long periods thereafter, especially if the rat harborages have not been eliminated by proper rat-proofing methods.

Prior to 1924 all efforts toward rat eradication or control were directed to the destruction of rats already living on ships and to preventing them from gaining access to the vessel. Most countries had taken measures to accomplish this purpose; but nothwithstanding the rigid enforcement of such regulations, permanent rat life on many ships, as shown by the examples cited above, was neither eliminated nor controlled. It was very evident that this apparent failure was due to some fundamental cause which, even if recognized, had not been appreciated nor taken into consideration when the measures for eradication and control were put into effect. What is that cause and what relation does it bear to the continued existence of rat life on ships?

The cause is *rat harborage*, both structural and incidental, which exists on board, coupled with easy access to food supply. It is primarily rat harborage, since it is not practicable completely to control access to food. The rôle of rat harborage as the fundamental cause had not been given serious consideration prior to 1924.

There is a very definite relation between prevalence of rat life on ships and the existence on board of the many inclosed dead-air spaces, now designated as rat harborages. There may be some instances of ships having harborages and no rats, but there is no record of any instance in which any appreciable number of rats has been found living on board without the discovery of extensive rat harborage in actual use by these rodents.

It may be safely said that the wanderings of rats are incidental to their struggle for existence. They are looking for new and noncompetitive sources of shelter, and seek to be safely protected, to eat, to drink, and to reproduce. In terms of available food and harborage, there is always a tendency toward a relative overpopulation of rats, and the excess must find new homes and new food supplies or perish. They are not interested in traveling because of a tourist's passion to see the world; their quest is for a permanent home with protected inclosed spaces for breeding purposes where their young may be safely reared to maturity. This is the fundamental reason for their presence on ships; and because of the splendid opportuni-

ties offered in the past for home-making on the average ship, reproduction has been carried on with but little interference, with the result that the rat population on board has either remained stationary or has been but slightly decreased, notwithstanding fumigation, trapping, poisoning, and similar measures. The fecundity of rats in nature offsets factors inimical to the perpetuation of the species. Most of the rats found on any given ship were born there and live there all their lives, and only leave it accidentally or as a result of unfavorable developments respecting their situation on board, such as epizootics, overpopulation, unattractive cargo trade, etc.

Of course, during the carrying out of periodical eradicative measures, many rats are killed, but there are practically always some survivors; and since the same favorable housing and breeding facilities remain, there is a resumption of reproduction, with its resulting rapid replenishment up to the original numbers.

The following information as to the breeding habits of rats is abstracted from the Public Health Service publication entitled "The Rat and Its Relation to the Public Health:" [1] "Rats breed from three to five times a year, each time bringing forth from 6 to 19 young, after a gestation period of 21 days. The young are blind and naked when born, but grow rapidly; and young females are capable of breeding when less than three months old."

The following quotation taken from a Public Health Service publication entitled "A Rat and Rat-Flea Survey of Ships at New York" [2] gives some pertinent and corroborative information as to the relation of rat harborage to the continued existence of rat life on vessels: [3]

"The fact that heavily rat-infested ships usually remain in this category, despite repeated fumigation, is taken to be good evidence that they carry a well-intrenched colony that can not be entirely eliminated by this means, the survivors renewing the rat population between fumigations. This is supported by observations in the laboratory that lots [groups] of rats from individual ships generally contain many young ones, and further by the trapping of rats on some of these vessels immediately after fumigation. That rats could be trapped on ships after fumigation, has been demonstrated by numerous observers.

"The maintenance of such colonies must be due to structural peculiarities that offer retreats, accessible to the rats, but too remote for the lethal gases to penetrate within the two hours' exposure allotted for fumigation. That this is the true status is amply borne out by careful inspections that have been made on many relatively heavily infested vessels, on every one of them being found various extensive and remote rat harborages."

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[1] Pub. Health Bull. No. 30.
[2] Reprint No. 1267, from Pub. Health Rep., vol. 44, Mar. 1, 1929.
[3] Pub. Health Bull. No. 30.

In a chapter entitled "The Rat in Relation to Shipping," in a Public Health Service publication,[3] the following conclusions are reached: "The constant and universal presence, then, of rats on shipboard can not be doubted"; that "Rats got on board and bred even in new ships considered modern at that time"; that "These vessels were new, were freed from rats by careful and repeated fumigation, and touched at no wharves save Honolulu and San Francisco, where constant antirat precautions were observed, and yet they were badly infested on their second trip." The confirmation of the fact that a large number of ships became rat infested in the shipyards during construction very probably explains the cause of the condition mentioned above.

Present Methods of Rat Eradication

FUMIGATION, TRAPPING, POISONING

The fumigation of vessels had been considered for many years the chief defense against the importation of bubonic plague. It has been given careful observation and study. Its efficiency has been increased and the delay it causes vessels has been shortened, chiefly through the adoption of the use of hydrocyanic acid gas which, in some form, has practically replaced sulphur dioxide, carbon monoxide, and other ship fumigants. While regular fumigation of vessels has undoubtedly lessened the possibilities of the spread of bubonic plague, it alone can not be depended upon entirely to eliminate the danger, as a variable number of rats survive the application of that measure, the number surviving usually being in direct ratio to harborage conditions existing on board.

Ship fumigation has two faults: First, it is usually most effective after the ship has discharged and the ship's rats may be carried ashore meanwhile in cargo; and second, it rarely kills all the rats, owing very largely to inherent protective harborage conditions existing on board of most vessels.[4] It is generally recognized and acknowledged that where rat harborage exists in a ship under fumigation there are practically certain to be survivors, and these will soon multiply. A recent publication [5] states: "Fumigation does not eliminate rats where any considerable harborage exists."

A similar statement was made by the authors in 1913: "There are many vessels that have old wooden partitions or other structures that may harbor rats through a long and severe fumigation." [6]

Trapping and poisoning are rat eradicative measures in very general use, especially abroad. These are effective only against the

[3] Pub. Health Bull. No. 30.
[4] Reprint No. 423, from Pub. Health Rep., vol. 32, Sept. 7, 1917.
[5] Loc. cit., footnote 2.
[6] Reprint No. 132, from Pub. Health Rep., vol. 28, June 30, 1913.

rats that are large enough to run around; and, because of the fact that on most ships a normal food supply is always available, many rats avoid the traps and decline to partake of the poisoned bait. These methods, at best, are productive of only temporary results, since they fail to remove the real cause—rat harborage. Interference with its natural breeding, rather than the carrying out of destructive measures against the adult form, is regarded, from a scientific view point, as the more effective way to control a biological pest.

While the plague fighter traps rats systematically, he does not do so to control plague, but to locate the foci of infection in the rat population. Each rat caught is tagged to show where and when it was captured. At the laboratory each rat is examined to see whether it is plague infected. Thus the limits and progress of the disease are recorded, but no permanent effect on the number of rats nor any great diminution of the plague infection can be expected from trapping alone.

Definition, Purpose, Need, and Importance of Rat Proofing

The term "rat proofing" as applied to vessels may be defined as the process of preventing rats by mechanical means from gaining access to and using inclosed spaces (termed rat harborages) for the purpose of hiding, nesting, or breeding, and of depriving them of the opportunity to obtain an adequate food supply by protecting the compartments where food is stored.

A rat-proof ship, therefore, may be considered as one on which it is so difficult for rats to hide, nest, or gain access to food as greatly to curtail their existence and propagation to a point of ultimate disappearance on board.

The purpose of rat proofing is to eliminate rodent life from ships or to keep it under permanent control by abolishing all harborages that might be used for nesting and breeding and by preventing access to compartments containing food supplies. It strikes basically at reproduction and its aim is to eliminate the principal biological necessities—a protected home and nest in which to shelter and rear the helpless young and an available food supply—in the absence of which successful propagation is impossible.

The average ship has many inclosed spaces admirably suited for rat homes; in fact in many instances it almost appears that they were designed for that purpose. Rats have promptly taken up their abode in them and have become so strongly entrenched in their possession and use that in many cases they have successfully resisted all customary efforts permanently to dislodge them.

Conditions similar to those previously described were found to exist on so many vessels that at times in the past it was felt that the rat problem, so far as ships were concerned, was practically hopeless, or at best a most difficult one. No one had thought then of applying to ships rat proofing, so highly valued for buildings. We now know that while it has lost none of its importance as applied to buildings, it is at least just as valuable and efficient when applied to vessels.

Since 1900 the Public Health Service has gained valuable experience in the practical control of bubonic plague. Confirming the findings of the Indian Plague Commission, plague workers in this country have considered the rat to be the main factor in the spread of the disease, and at the same time the most vulnerable link in the chain of spreading the infection. Hence, control measures were primarily directed against this animal, and only secondary consideration was given to infection transmitted by human cases or by fleas. An outstanding permanent contribution to the knowledge of plague control was the demonstration that rat proofing is essential to success.

In 1910 the Public Health Service (then the Public Health and Marine Hospital Service) issued a publication entitled "The Rat and Its Relation to the Public Health",[7] written by various authors, most of whom had taken an active part in antiplague work. This publication urged the rat proofing of buildings and stated that it could be accomplished by the abolition of rat harborages, the interruption of rat travel, and the protection of rat food; that disinfecting procedures must be regarded as of minor importance in plague prevention, and that time and money should not be wasted nor a feeling of false security engendered, by using an impermanent measure when others, such as rat proofing, of much greater permanent value are at hand; that "Rat destruction is of doubtful value," because, "as rat population decreases, the breeding rate among survivors increases, due * * * to relatively increased food supply and harboring facilites; that rat proofing is of the greatest value as an antiplague measure and practical results to be expected are much greater than with any other method."

The experience gained and the results that have followed the application of rat proofing to ships during the past six years have demonstrated in a very convincing manner that this method plays a most important rôle in the maintenance of permanent control of rat life on vessels.

Rats may get on a rat-proof ship just as they may enter a rat-proof building; but once on such a ship it will be impossible or difficult for them to hide, except in cargo or stores, which will afford

[7] Pub. Health Bull. No. 30.

only temporary shelter. They will be unable to travel from one compartment to another in search of food or water. In other words, modernly expressed, they are confronted with a " high cost of living " due to an acute housing problem and lack of transportation facilities between home and business (food procurement). Laboring under these disadvantages, they will even kill each other in the fierce competition for the necessities of life or die of hunger and thirst. In addition, they can be caught or destroyed more easily owing to the absence of protection. They will breed slowly, and, instead of increasing, will actually decrease in numbers.

A rat-proof ship is subject to less destructive damage by rats, is cleaner, is preferred both by passengers and shippers, is less likely to carry bubonic plague, and, consequently, less likely to be subjected to the delays and expense of quarantine procedures, and it permits of more effective fumigation when that measure is indicated, as in certain instances of rat-harboring cargo from plague-infected ports.

The Development of Rat Proofing of Vessels

It is generally recognized that the most effective way to control a biological pest, whether animal or insect, is to restrict or interfere with its natural breeding, and that destructive measures against the adult form are costly, less effectual, and justified only in cases of emergency or where the situation is temporary. The various methods of rat eradication, other than rat proofing, now employed have a limited usefulness, but they do not strike at the root of the trouble and remove the cause, through the elimination of the conditions that are favorable for rat propagation. Rat proofing does this and restricts breeding by depriving rats of the two most important biological necessities—inclosed spaces for nesting and food supply.

As a result of a number of experiments and observations made by the authors in 1912 in connection with plague eradicative and preventive measures, it was discovered that the principal reason why some rats survived fumigation was because they availed themselves of the well-protected shelter existing in the inclosed spaces behind double walls, under deckheads, ceilings over tank tops, boxed pipe casings in holds, etc., and further, that they used such places for breeding purposes, many nests containing young rats having been found when these inclosures were opened. Such conditions were found to exist on board practically every ship that was fumigated, and their prevalence seemed to require not only special and radical treatment to combat them, but to demand an extensive study to ascertain the cause and the measures necessary to correct or remove them.

At that time, under the pressure of work incident to the suppression of an actual epidemic of bubonic plague, there was no opportunity to do any great amount of constructive work. Action was limited to the making of surveys of conditions, collecting data for future use, and observing the effect of the special corrective measures that had been inaugurated and employed. These consisted principally in the opening of all inclosed spaces that afforded harborage and a safe refuge from the effects of the fumigating gases. The places that were again closed after each fumigation were frequently found to become reinfested with rats. Those that had been opened in a permanent manner, it was observed, had remained rat free. In other words, they had been "rat proofed." The authors expressed the opinion at the time (1912) that the rat proofing of vessels should be done, if for no other purpose than to increase the efficiency of fumigation. This was the beginning of the work of the rat proofing of vessels.

While the subject had been given serious thought during the interval of years, and some progress had been made in outlining the methods which might be employed, it was not until 1923, when the authors were on duty at the New York quarantine station, that the opportunity was presented for a resumption of the study of the problem and for the inauguration of actual rat proofing work as a definite operation, independent of fumigation. The chance for a try-out of this new idea came in a unique way.

One of the finest steamers afloat, the "queen" of the line, had many rats on board. The general manager employed rat catchers when in port and had traps set at sea. Many rats were caught, but many always remained. We suggested that one of our best trappers be signed on as a member of the crew to study the problem. This man studied conditions for several weeks. The hiding places, movements, and habits of each colony of rats were observed, charted, and recorded with remarkable accuracy. As there were many rat colonies, there were just so many separate problems. These were taken up one at a time, an attempt being made to keep the rats out of their natural nesting places and to make food inaccessible to them. As the work progressed and the living conditions of one colony after another were interfered with, the number of rats trapped decreased steadily. The statements of persons on board and the absence of rat signs indicated that the rats which previously infested all parts of the ship had disappeared. Just what had to be done in each instance was specified by our force; but the work of rat proofing was actually done by the carpenters or metal workers belonging to the ship or employed for the purpose while the ship was in port.

Before the work on the first ship had been completed, its success was recognized and the managers of other lines began to ask for assistance.

The foundation for the work of rat proofing vessels was thus laid, and the structure of the present technical system was gradually built upon it. Its development was of slow growth, each feature being carefully studied from every angle—efficiency, economy, practicability, possibility of installation from a technical viewpoint, etc., before being adopted.

Since one of the main objects of rat proofing was to control breeding by eliminating harborages and depriving rats of the use of inclosed spaces, every corrective measure that was planned had to be based on its ability to do this effectively. In other words, the real job was to build the rat out and keep him out by mechanical means. It was accomplished in either of two ways: First, by elimination of the inclosed space, or second, by protecting the inclosed space in such a way that the rat could not get into it. This principle comprised the first fundamental rule for the rat proofing of inclosed spaces. All problems of this kind were solved by the application of one or the other of these two methods—elimination or protection. Elimination, of course, is the most logical, the most efficient, and the most economical in the long run, since it is permanent and requires but little or no upkeep.

The second fundamental rule applied to the rat proofing of compartments and inclosures, especially those containing a number of fixtures or used for the storage of bulk supplies. It provided for (1) either the rat proofing of each fixture in such compartment, or (2) the protection of the entire outside partition bulkheads, making it impossible for rats to get in that compartment—that is, to provide an impregnable outer line of defense.

While the location, general character, etc., of the many spaces customarily used by rats as harborages were known, the full extent of such use was not ascertained until after many methodically conducted surveys had been made on a number of ships and the unsatisfactory conditions found had been carefully studied and analyzed. Some interesting and amazing discoveries were made, which attested to the intelligence, craftiness, and resourcefulness of the rat.

From the data and information obtained as a result of these surveys and inspections, every section and compartment of the average ship where rat harborage was found to exist was charted on the key plan, and a brief description of the defect made on the "index" to the key plan. Fifty-three typical examples of structural or incidental defects which are responsible for existing harborages were found and listed in the index to the key plan, which is given elsewhere in this publication.

The correction of each defect was planned with care, and a typical detail drawing and a working model were made of each. Both the drawing and the model were used as guides in the execution of rat-proofing work and in the promotion of the standardization of the methods employed.

In the development of the work of the rat proofing of vessels it was realized that the subject would have to be studied from a great many angles and general information acquired relative to the construction, upkeep, and operation of ships and the laws governing same, so that intelligent consideration could be given to any technical, legal, or other obstacles that might stand in the way of its adoption and execution. Factors such as conflict with technical rules and regulations of other governmental departments or official bodies exercising control over certain phases of shipbuilding and operation, the practicability of installation of the many features proposed from a technical and mechanical viewpoint, as well as that of selection of material, permanency of installation, cost, etc., were fully considered from every angle. The acceptance, approval, and adoption by The American Marine Standards Committee of the methods proposed and employed attests to their technical value.

It was recognized further that, in order to maintain a high degree of efficiency, provision must be made for the permanent upkeep of rat-proofing work, and that the operating personnel of the various companies ashore as well as on the ships should be properly instructed, so that they might give intelligent cooperation. Suitable instructions were embodied in a standard circular which was issued, and which is included in this publication.

The work has steadily grown until at the present time more than 75 per cent of the better-class passenger ships entering the port of New York have been or are in the process of being rat proofed. The following statistics disclose some interesting facts in regard to the growth of the work and its spread to other countries. The figures are for the port of New York and have been corrected up to January 31, 1931:

Number of vessels, completed or being rat proofed	270
Number of owning or operating companies	44
Number of nations to which these ships belong	13

The number of vessels sailing under the various flags are as follows:

American	107	Dutch	7
British	74	French	4
German	18	Chilean	3
Swedish	11	Danish	3
Norwegian	21	Republic of Panama	1
Italian	8	Japanese	5
Spanish	8		

In addition to these, 14 vessels now under construction in the various yards in the United States are being completely rat proofed, in accordance with the standard specifications for the rat proofing of ships, as required under the provisions of the Jones-White shipping law.

Several vessels now under construction in foreign shipyards have incorporated the rat-proofing requirement in their building program.

It was difficult at first to convince the average seafaring man that a rat-free ship was possible. Rats had so long been accepted as shipmates that rat proofing was often rejected without a hearing. Popular interest in the movement was stimulated by scientific and popular articles, by exhibition of models, and by demonstration on board ships.

Rat proofing, while essentially a public health measure, has an economic side, and because of this it makes a direct appeal to the average shipowner and operator. When the work is properly executed and maintained, it so controls rat life on board ship that there is little or no damage to valuable cargo and no annoyance to fastidious passengers, and, as a consequence, no direct or indirect financial loss from these sources. It is because of this that the rat proofing of vessels is meeting with such success in all ship-operating countries. A marine superintendent of a prominent line writes: "Personally, I am so convinced that rat proofing of ships will solve our rat problem * * * that I recommend it both because it is dictated by economy and good management, and because the action of each individual will benefit shipping as a whole.

It is, therefore, a rare example of that dream of the health officer—a sanitary measure voluntarily performed by business, regardless of law or regulation, because it will save money.

The Efficiency of Rat Proofing

Rat proofing is more effective on ships than on shore. In the first place, ships are only periodically exposed to reinfestation during comparatively short periods while alongside of the wharf, and ordinarily the majority of rats on board are bred on board, whereas buildings on shore are continuously exposed to new infestation. Second, merchandise, as cargo in transit, is more frequently moved than when stored in warehouses and in itself furnishes less protracted protection on shipboard for rat breeding.

This efficiency has been shown repeatedly. First, by the observations of the officers and crew operating vessels, which must be accepted as reasonable proof. A large number of reports have been made to the effect that before rat proofing was inaugurated, rats were present in degree from "a few" in some cases, to "rats everywhere" in others, and that as rat proofing progressed, the

rats were reduced in numbers or eliminated. It is frequently stated that rats continue to get aboard a rat-proof ship, but that they die of starvation or are easily killed.

Second, by the results of trapping and fumigation. Where these measures have been continued during or after rat proofing, the yield has been progressively reduced in proportion to the amount of rat proofing accomplished and the care given to its upkeep. A recent publication [8] of the United States Public Health Service states that, "On ships that are considered practically rat proof at this (New York quarantine) station, fumigations have yielded very few or no rats."

Third, by the results of rat-infestation inspection. These inspections make a record of gnawings, evidence of rat runs, presence of rat excreta, and similar indications of rat prevalence in every part of the ship before, during, and following rat proofing. Records of over 200 ships show a consistent reduction of rat evidence as rat proofing progresses. They also show that, in general, the amount of space in the ship's structure suitable for rat breeding and the existence of rat runs which allow them to go to wherever there is food, determine the extent of the ship's permanent population.

A few typical examples may be mentioned. The steamship ———, carrying grain outbound, formerly had many rats. For over a year an average of 20 rats a trip were caught in the provision storerooms alone. The vessel's last fumigation was in March, 1925, when 11 rats were killed. Trapping immediately afterwards also yielded 11 rats. Rat proofing was begun in May of the same year, and many rats were killed as their nesting places were destroyed. Careful inspections were made every month during 1926, 1927, 1928, 1929, and 1930. In 1926, two rats were found; after that time no evidence of any kind was discovered, although the vessel continued regularly to carry grain, which is customarily considered inseparable from concurrent rat infestation.

The steamship ———, a new vessel put into commission in 1926, was found to be badly rat infested. The most casual observer could see rat signs and rat damage almost everywhere. As many as 30 rats were reported as being actually seen at one time. Rat proofing was begun in March, 1927, and gradually but completely "built out" these hundreds of rats without resorting to trapping or fumigation. Since that time repeated inspections and the testimony of ship's officers witness that the vessel is rat free.

A comparison of the "around-the-world" Japanese steamship *A*, and the American steamship *B* in the West Indian trade, is especially convincing. These two vessels, both continuously infested

[8] Loc. cit., footnote 2.

with many rats, were treated differently, and the results were watched for a considerable time. The steamship *A* arrived at New Orleans in 1926 with two cases of bubonic plague among the crew, and, consequently, was thoroughly fumigated five times, with a total yield of 431 rats. Rat proofing was advised and detailed specifications were given, but little satisfactory work was done. The vessel was subsequently fumigated three additional times during 1927, with a yield of 46 rats and an estimate of 150 rats killed but not retrieved. On this basis the rat population within one year had returned to over 40 per cent of its original size in spite of repeated fumigations. The steamship *B* was rat proofed in 1927 by a mechanic trained for this work who carefully carried out the specifications drawn up at the New York quarantine station. The work was completed in August, 1927, but the results could not be estimated until June of the next year, when the boat came to New York. During all this time but two rats had been seen and these were easily killed. No evidence of rats could be found when the vessel arrived at New York. The vessel continued its trips to the West Indies, was not fumigated, and was subject to no precautions against rats. Nearly a year later it was again inspected in New York, but still no evidence of rats could be found.

Comparing the two vessels, it will be seen that the Japanese ship was freed from rats so far as possible by fumigation, but its rat harborages were not abolished and the result was a prompt return of rat infestation. The American vessel, rat proofed while pursuing its regular trade, succeeded in becoming rat free without fumigation.

A record has been kept of the rat infestation inspections of each trip, which have been made on the 270 vessels that either have been rat proofed or have that work under way. Some of these records cover a period of six years. The great majority of these ships had been rat infested prior to beginning rat-proofing work.

Some of the results of rat proofing as shown by these records are as follows:

Six vessels of an American steamship company engaged in North Atlantic trade (five formerly rat infested) have been found free from rats for the past three years, and have not been fumigated for five years. Five of these ships carry grain each trip.

Five vessels of another American company engaged in a similiar trade (three formerly with some rat infestation) have been free from rat life for two years. No fumigations have been performed on four of them for the past two years.

Of 22 vessels belonging to a large British steamship company trading in the North Atlantic (19 of which formerly were rat

infested), 18 have been free from rats for nearly two years, and on the remaining four the rat population has been reduced to relatively unimportant numbers.

Fifteen vessels of a British company engaged in the round-the-world trade have remained rat free for periods ranging from two to five years. These are new vessels and have never been infested.

Three vessels of a Swedish company conducting a passenger and freight business in the North Atlantic (all three were formerly rat infested) have been found free from rat life for three years, as verified by fumigation and monthly inspections.

Four Italian passenger vessels (formerly rat infested) engaged in the New York-Italian ports trade have been rat free for more than two years, as verified by fumigation and monthly inspections.

Two Italian passenger vessels engaged in the same trade (formerly badly rat infested) have reduced their rat population to a relatively unimportant number.

Six American combination passenger and freight vessels engaged in the trade to the west coast of South America have remained free from rat life for nearly two years, except for several rats found on two of them on two isolated occasions.

Twenty American freight ships trading to the Near East and ports of the Mediterranean (16 of which were formerly rat infested) have reduced their rat life to the disappearing point, and 10 of them are now rat free, as verified by fumigations and inspections.

Of 16 German passenger and freight vessels plying between Germany and New York, 14 are entirely rat free and have been in that condition for from two to four years, as verified by fumigation and inspections.

Two Norwegian passenger and freight steamers trading between Norway and New York (one of which was formerly badly infested) have been free from rat life for two years, as verified by monthly inspections.

Five American combination passenger vessels engaged in the West Indian trade (all of which were formerly heavily rat infested) have been rat free for approximately two years, except for several stray rodents that have come in with fruit cargo from time to time, as verified by monthly inspections.

Five Norwegian round-the-world freight vessels, built within the past two years, have remained entirely rat free during the time they have been in commission, as verified by fumigation and periodical inspections.

Numerous similar cases could be cited. A table arranged chronologically, showing a typical progressive decrease in rat life on a

large passenger ship as the rat-proofing work advanced, is given herewith. It covers a period of four years and nine months. This vessel is still rat free (January, 1931).

CHRONOLOGICAL RAT HISTORY OF A LARGE PASSENGER SHIP

Rat history prior to October, 1924.—Vessel was reported to have a large number of rodents in the living quarters, galleys, pantries, mail rooms, baggage rooms, dining rooms, crew's quarters, etc. The surveys and inspections revealed the fact that the ship was very badly rat infested in practically all compartments. Trapping was carried out in accordance with standard methods and was uniform in character for the entire period. Verified by trip inspections and official records.

Voyage No.	Date	Rats trapped in port	Rats trapped at sea	Total for voyage
	1924			
17	October	60	0	60
18	November	47	2	49
19	Dec. 2	0	44	44
20	Dec. 23	60	25	85
	1925			
21	January	12	24	36
22	February, March, April	17	168	185
24	May	7	7	14
25	June	6	6	12
26	July 1	3	2	5
27	July 20	9	12	21
28	Aug. 10	10	15	25
29	Aug. 31	12	7	19
30	September	9	1	10
31	October	3	2	5
32	November	6	2	8
33	Dec. 3	4	1	5
34	December	4	1	5
	1926			
35	January	10		10
36	January and February	4		4
37	March	7	1	8
38	April	7	1	8
39	May	10		10
40	June	4		4
41	July	5		5
42	August	4		4
43	Sept. 6	3		3
44	Sept. 27	3		3
45	October	5		5
46	November	7		7
47	do	3		3
48	December	1		1
	1927			
49	February	2		2
50	March	3		3
51	April	0		0
52	May	4		4
53	do	3		3
54	June	1		1
55	July	1		1
56	do	1		1
57	August	2		2
58	September	0	0	0
59	October	0	0	0
60	do	0	0	0
61	November	0	0	0
62	December	0	0	0

Voyage No.	Date	Rats trapped in port	Rats trapped at sea	Total for voyage
	1928			
63	February	0	0	0
64	Mar. 3	0	0	0
65	Mar. 24	0	0	0
66	April	0	0	0
67	May 5	0	0	0
68	May 26	0	0	0
69	June	1	0	[1] 1
70	July	2	0	[2] 2
71	Aug. 4	0	0	0
72	Aug. 25	2	0	[3] 2
73	September	0	0	0
74	Oct. 6	0	0	0
75	Oct. 27	2	0	[4] 2
76	November	0	0	0
77	December	0	0	0
	1929			
78	Feb. 6	0	0	0
79	Feb. 27	2	0	[5] 2
80	March	0	0	0
81	April	0	0	0
82	May 4	0	0	0
83	May 25	0	0	0
84	June 12	0	0	0
85	June 29	0	0	0
86	July	0	0	0

[1] Killed in gangway of second-class galley.
[2] Trapped in pastry room.
[3] Killed in No. 2 hold.
[4] Killed in cargo in No. 2 hold.
[5] Trapped at gangway.

Relation of Rat Proofing to Requirements of the International Sanitary Conventions

The International Sanitary Convention of Paris, revised 1926, recognizes that a vessel can be permanently kept in such a condition that rat population is reduced to a minimum. Article 28 of this convention provides that ships must be periodically deratized or be permanently so maintained that the rat population is reduced to the minimum. Ships that are rat proofed and effectively maintained are acceptably free from rats, so that all nations may exempt such ships from periodic fumigation.

The form of the certificate that has been adopted for international use has spaces to be filled in for the purpose of recording rat-harborage conditions and evidence of rat infestation as found in all parts of the ship. It has been definitely shown that a careful and systematic examination will reveal the presence or absence of evidence of rats and allow a reasonably accurate estimate of the degree of their prevalence on board. Consequently, if fully filled out these international standard certificates are acceptable at face value. Their accuracy may be easily verified by taking certain parts of the ship as samples and checking the conditions found against those reported on the certificate.

The Permanent Committee of the International Office of Public Hygiene, acting under the provisions of the International Sanitary

Convention of Paris, 1926, and prior conventions, officially indorsed rat proofing at its meeting in Paris in May, 1929, as follows: "The committee insisted on the motives which inspired the writers of article 28, and which are not to require ships to undergo systematic deratizations but to use that measure only in case of real necessity and, by granting a sort of privilege to ships kept free from rats, little by little and more and more to bring about rat proofing."

This committee at its meeting held in Paris in May, 1930, further indorsed rat proofing of ships in a report submitted relative to the application of article 28 of the convention: "In a general way, the experience acquired from the beginning of the functioning of the system established by article 28 is favorable. The progressive decrease in the number of rats on board ships is expressed in the ever-increasing number of cases in which (for example, in Great Britain) it has been possible to issue certificates of exemption to ships of different countries. The development of rat proofing can only further the progress thus made."

To date the International Sanitary Convention of Paris, 1926, has been ratified by the following countries:

Australia (without Norfolk Island, but with Papua and territory under mandate of New Guinea).
Belgium.
Brazil.
Canada.
Czechoslovakia.
Denmark (Greenland and Faroe Islands not included).
France (together with French colonies and territories under French mandate).
Germany.
Great Britain and Northern Ireland.
Greece.
Hungary.
Irish Free State.
Italy.
Luxembourg.
Mexico.
Monaco.
Morocco.
New Zealand (with western Samoa).
Rumania.
Salvador.
Sudan.
Spain (without Spanish territory in the Gulf of Guinea).
Tunis.
Union of South Africa (without territory under mandate of Central and eastern Africa).
United States of America.
Union of Socialist Soviet Republics.
Venezuela.
Yugoslavia.

This convention constitutes the standard of procedure with respect to quarantine and related sanitary matters for all adhering governments.

The quarantine regulations of the United States, in accord with the provisions of the International Convention, provide that the necessity for periodic fumigation of a vessel shall be based upon evidence of the presence or absence of rats on board. The existence of rat harborage constitutes presumptive evidence of potential rat infestation. On the other hand, the absence of rat harborage ordi-

narily would warrant the assumption that a minimum number of rats are likely to exist on board.

At the meeting of the Eighth Congress of the Far Eastern Association of Tropical Medicine held in Bangkok, Siam, in December, 1930, the following resolution was adopted: "This congress is of the opinion that the most permanent, reliable, and economical method of preventing the transfer of plague from port to port through the agency of shipping lies in the rat proofing of vessels. We consider that this method should take precedence over all others."

Rat Proofing and New Construction

The Public Health Service has shown the sanitary and economic advantages of rat proofing, and private enterprise is carrying it on.

There is persistent demand from shipbuilders all over the world for information regarding rat proofing. This publication is planned to meet this demand, as its drawings and photographs speak an international language. Many rat-proof vessels have already been built in foreign countries. Many American ship constructors now regard rat proofing to be of cardinal importance, and, upon request, experts of the Public Health Service have regularly visited certain shipyards to instruct shipyard personnel in the principles of rat proofing and to demonstrate these principles on vessels under construction.

General Instructions

In promulgating these instructions for the rat proofing of ships, the American Marine Standards Committee of the Department of Commerce made the following statement:

> Acting upon the suggestion that the basic principles of rat proofing should be standardized in the interest of uniformity of practice and economy, the American Marine Standards Committee has, in collaboration with the United States Public Health Service, and with advice from other sources, compiled the instructions herein presented. These instructions establish general principles intended for guidance in specifying the rat-proofing work actually required on different ships. New ships can generally be planned and constructed so as to minimize special work. The extent of such work required on old ships depends upon their structural type and condition. The degree to which the instructions can be directly applied to any ship is left to the judgment of those concerned.

These instructions are quoted here without change or comment. Drawings and photographic illustrations are of value to those interested, and a sufficient number of these have been added in this article to illustrate an efficient way to handle every phase of rat proofing that has been found. Numbers inserted in the instructions of the American Marine Standards Committee correspond with similar numbers in the drawings and photographs. These illustrate the common defects and show graphically how the instructions for their correction should be applied.

The upkeep of rat-proofing work and the enforcement of measures on board of ships that will insure the elimination of incidental harborage in dunnage, old material, etc., was considered of such paramount importance that a special circular was issued entitled "Suggestions for Use in the Carrying Out of the Program of Rat-Proofing Work and the Proper Maintenance of Same, on Board Vessels." This circular was distributed to a number of interested steamship companies. Following the suggestions made therein, many of the operating officials issued circular letters on the subject of rat proofing in which the attention of the commanders of the vessels of their fleet was called to the importance of complying with its provisions. Copies of the circular and a typical letter of instructions issued by a steamship company operating a large number of freight vessels appear in the appendix.

Rat Proofing of Ships

GENERAL INSTRUCTIONS[9]

1. General Notes.

(*a*) Design and construct each compartment, section and subdivision so that it will be an isolated rat-tight space. This means the elimination or the effective rat proof closing of structural openings.

(*b*) Avoid, as far as practicable, dead spaces in the structure, such as between the shell frames, etc., and ceiling or sheathing, also hollow bulkheads or partitions. Where such can not be avoided, make the spaces effectively inaccessible to rats.

(*c*) It is advisable from the rat-proof standpoint to use forepeak and afterpeak spaces as tanks rather than for stowage of boatswain's or other stores. If used for stores, install facilities therein for open and orderly stowage, such to be laid out as far as practicable to avoid rat harborage.

(*d*) Paint the walls of shaft alleys white or other light color and provide ample illumination. Discontinue their use for stowage of supplies unless inclosures or containers are provided therefor as described under section 11.

(*e*) Bilges of ordinary type offer inducements to rat life which can be eliminated by making and keeping all limber and wooden floor coverings rat tight and by screening or closing all openings through screen bulkheads which would permit rats to pass from one compartment to another.

(*f*) Air spaces in insulated walls or ceilings offer harborage for rats, therefore, if the design of the ship so permits, isolate the galley and other heated spaces as far as practicable in order to avoid the necessity to insulate or sheathe the sides or ceiling.

(*g*) These instructions apply most directly to new construction. They can, however, be generally complied with in rat-proofing ships in service without making any extensive structural alterations. Various inexpensive methods can be adapted to existing construction that will effectively serve the purpose along the lines indicated.

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[9] Compiled and promulgated by the American Marine Standards Committee. Approved Feb. 8, 1929, as American Marine Standard II No. 41–1929. Issued by the Department of Commerce.

2. Ship's Structure.

Close with sheet metal or wire mesh—

All unavoidable structural openings in floors, decks, bulkheads, or partitions, for pipe lines, cables, conduits, drains, beams, stringers, stanchions, etc. [Drawings 1, 5, and 8, 6, 17.]

All openings through structural members, such as stringers, beams, etc., adjacent to bulkheads. [Drawing No. 2.]

All partly concealed recesses formed at intersections of reinforcing girders, stiffening plates and other structural parts; spaces around or above side ports; spaces at the bases or tops of built-up pillars, and generally similar spaces between structural parts which would afford harborage to rats. [Drawings 9, 9a, 10, 41, and 41a.]

3. Ceilings and Sheathing in Cargo Spaces and over Bilges.

(*a*) Make ceiling over bilge brackets of steel tightly fitted at all edges. If built of wood, cover joints, defects, and edges with sheet metal. [Drawing 3.]

(*b*) Use sheet metal where practicable instead of wood for filling pieces between frames as base for a concrete or cement slope. Make the concrete slab at least 2 inches thick. If the concrete or cement slab is less than 4 inches thick, or in any case if it is laid on wood, reinforce it with expanded metal or wire mesh so as to prevent cracking and disintegration. [Drawing 2 and 4.]

(*c*) Construct lower holds so that there will be no space under the flooring accessible to rats. Omit flooring in holds over inner bottom tanks where practicable. If protective flooring is required, fit the planking closely to the tank top, using only thin furrings imbedded in suitable material, such as asphaltic cement mixture or bituminous composition. Where tanks are used for fuel oil, the rules of the ship classification societies require battens under ceilings, where fitted, to be from 1½ to 2 inches thick. [Drawing 3.]

(*d*) In vessels or spaces without double-bottom tanks, construct steel floors in holds in preference to wooden ones. If wooden ceiling is required under hatches or elsewhere for protection in cargo handling, lay it as specified in the preceding paragraph. [Drawing 3.]

(*e*) Install 6-inch metal strips along the bottom, top, and other points of wooden ceiling where gnawing is possible. [Drawings 1, 5 and 8.]

(*f*) Where wooden sheathing is light and susceptible to damage in cargo handling, protect it with battens spaced 6 to 8 inches apart, to guard against such damage as would permit passage of rats, invite gnawing, or afford rat harborage. [Drawing 5 and 8.]

(*g*) Wherever openings are required in sheathing for air circulation, cover them with perforated galvanized sheet iron or wire mesh with a metal frame well fastened with bolts or screws. [Drawing 5 and 8.]

(*h*) Cover with sheet metal all openings along the edges, and holes in planking of protective wooden ceiling or sheathing over shaft alley, or other communicating tunnels. If the protective ceiling or sheathing is of metal, fit it so that there are no openings in or around it greater than one-half inch. If larger openings occur, close them with sheet metal. [Drawing 5 and 8.]

4. Bulkheads, Partitions, and Trunks.

(*a*) If permanent wooden bulkheads are required to protect cargo from tank leakage, construct them with thick tongued and grooved or splined lumber. If this is not practicable and plain lumber is used, cover open seams with sheet-metal strips. Fit metal flashings six inches wide around all edges.

Close with metal collars all openings through such bulkheads around pipes or other leads and structural members passing through them. [Drawing 6.]

(*b*) Fit wooden partitions snugly to the deck and ceiling. Cover open seams and close all openings around beams, pipes, etc., with sheet metal. Where there is no floor angle or other metal base for a wooden bulkhead or partition, flash the base with sheet metal as protection against gnawing. Fit and securely fasten metal flashing at other edges so that there will be no unprotected edge space wider than one-half inch. [Drawings 31, 35 and 36, 37B–B, 39.]

(*c*) Avoid, as far as practicable, open spaces either above or under partitions, panels, bulkheads, etc. Where such openings are necessary for ventilation or other purposes, close them with heavy perforated sheet metal or wire mesh substantially bordered. This applies to cases where partitions extend only up to the beams leaving openings between them and the ceiling above. [Drawings 37–sec. A–A, sec. A–B–C, sec. C–C.]

(*d*) Where wire partitions or grill work are used for inclosures, build them from floor to ceiling, using wire screen of one-half inch or finer mesh, with snug fits around beams, pipe lines, etc., so as to leave no openings exceeding one-half inch wide. [Drawings 20, 26A.]

(*e*) Avoid double or hollow-wall construction. Where such must be used, block off the internal spaces at all ends and partition points. If such spaces exceed 25 feet, block them off at intermediate points. This is effectively done by installing sheet-metal or wire-mesh pieces across the space. [Drawing 37–sec. C–C.]

(*f*) Close with sheet metal all openings or defects in bulkheads or partitions where gnawing might take place before building or installing anything against them. [Drawings 31, 37B–B, 39.]

(*g*) Make all trunks or shafts for dumb-waiters, etc., of tight construction and fit doors in them closely. Screen openings at top and bottom with perforated sheet metal or wire screen of one-half inch or finer mesh. Sheathe all unprotected wooden trunks or shafts with sheet metal.

(*h*) Construct window pockets in the superstructure so that there are no recesses or openings for rat ingress or harborage or sheathe pockets with metal. [Drawing 40.]

5. Insulation Sheathing.

(*a*) When wooden sheathing in refrigerator or cold-storage spaces is not to be completely lined with sheet metal, install wire screening of ½-inch or finer mesh back of the sheathing overlapped at joints about 6 inches and interlocked at corners, or cover all open seams, corners, and edges with sheet-metal strips or flashings wherever gnawing might take place. [Drawing 19.]

(*b*) Where insulating sheathing, such as cork or other material, is fitted, cover it with sheet metal fitted closely to the edges and around pipes, beams, girders, etc. Where the sheet metal can not be closely fitted and securely fastened around pipes or structural parts, protect uncovered surfaces of the insulating sheathing with heavy sheet metal. Secure edges of sheet-metal sheathing at such places with heavy metal collars, well fitted and secured. [Drawing 27 and 28.]

6. Doors and Other Openings.

(*a*) Where service doors are installed over or in conjunction with water-tight doors and the service doors have openings to clear the dogs or handles of the water-tight doors, protect these openings with suitable metal shields or linings.

(*b*) Close hatches with tight-fitting covers and screen ventilating skylights and trunks and other exterior openings with tightly fitted heavy-wire screens of ½-inch mesh. [Drawing 48.]

(*c*) Close with substantial metal collars all openings sufficient to allow passage of rats around stovepipes and other pipes leading through exterior bulkheads or decks. [Drawing 26A.]

(*d*) Make all doors and shutters tight fitting. Protect all openings which are normally open with closely fitted substantial screens. Fit effective closing springs on all service doors. Cover with metal sheathing the wooden threshholds, frames, and bottoms of wooden doors to storerooms and other inclosures where rats might gnaw through, especially those in unfrequented locations.

(*e*) Make the grating covers over shaft-alley escapes close fitting and screen them. [Drawing 15.]

(*f*) Screen under side of grating covers over fore and after peak hatches. [Drawing 11 and 12.]

7. Floors and Gratings in Storerooms, Etc.

(*a*) Avoid fixed hollow wooden floors or platforms in storerooms generally. Where flooring is required, install gratings in sections which can be easily handled, constructed flush on both sides and closely fitted, affording no spaces sufficient for rat runs or harborage. [Drawings 17, 17A.]

(*b*) Where fixed hollow floors must be used, block off the internal spaces at the ends and at frequent intervals with sheet metal or wire mesh pieces.

8. Pipes and Other Leads, Ventilators, Heaters, Etc.

(*a*) Protect all ventilation openings which are accessible to rats, also all openings of mechanical draft ventilators and ventilating ducts throughout the ship, with heavy-wire screens of ½-inch or finer mesh. [Drawings 42, 44, 45, 46, 47.]

(*b*) Where pipes which are to be insulated penetrate bulkheads or partitions, fit sheet-metal collars in accordance with the following [drawing 26]:

(1) When insulation terminates on each side of the bulkhead, place collar around pipe before applying insulation.

(2) When insulation is one-half inch or less in thickness, same may be continuous, passing through bulkhead. In this case fit collar outside of the insulation.

(3) When insulation is more than one-half inch thick, and it is desirable that it be continuous through the bulkhead, collars may be fitted outside of the insulation, provided that a sheet-metal cylinder, not less than 12 inches long, is also fitted over the insulation on each side of the bulkhead.

(4) On wooden bulkheads make the collars of such a diameter as to leave a margin of not less than 3 inches of flashing outside of the insulation.

(*c*) Where spaces which might afford rat harborage occur along ventilating ducts which run parallel with adjacent beams or bulkheads or between such ducts and the deck or ceiling, especially if they are less than 6 inches wide, or are not readily visible or accessible for inspection and cleaning, close them with sheet metal, including the ends, so as to effectively prevent rat ingress. [Drawings 37 D–D and 43.]

(*d*) Sheathe all recesses for fire hydrants, fire extinguishing and electrical apparatus, heaters, switchboard lockers, etc., with sheet metal fitted in such a manner as to leave no hidden space or possibility of openings to rat harborage. [Drawings 51, 52, 53.]

(*e*) Close lightening holes in motor bases with perforated metal plates or suitable wire-mesh screens. [Drawing 49.]

9. Casings over Pipes, etc.

(*a*) Make protective coverings for heating pipes or coils of perforated metal with perforations not over one-half inch. Fit these coverings closely so that there will be no openings at the ends or at joints greater than one-half inch. [Drawings 34, 34A.]

(*b*) Make all pipe protective casings, whether vertical or horizontal, of open (skeleton) type of construction. Build casings of open steel-bar construction wherever possible. Any one of the following optional types will give satisfactory results, the choice depending upon the materials and facilities available and the judgment of those concerned, provided that from the point of view of fire prevention, casings over steam pipes and electrical leads should in all cases be of metal [drawings 22, 23, 24]:

(1) A thick oak or other hardwood board or steel plate just wide enough to give proper protection to the pipe, to be bolted to and held in place by heavy U-shaped metal straps securely fastened to the ship structure, the ends of the board or plate to be 8 to 12 inches from the deck and ceiling. This type gives a clear view of the pipe.

(2) Open steel-bar construction typically similar to metal tree boxes, but heavier and with the ends 8 to 12 inches from deck and ceiling.

(3) Ladder type of construction consisting of wooden sides with ends 8 to 12 inches from the deck and ceiling, held in place by heavy angle clips securely fastened to the ship structure, the cross strips to be not over 2 inches wide and spaced as far apart as consistent with structural and service requirements.

(4) Where pipe lines, valves, or fittings are laid on or close to the floors in holds and must be protected by solid construction, make the latter of steel fitted in convenient sections, well secured with all joints closely fitted. If wooden construction must be used instead of steel, make the casings of heavy planking closely laid and metal flashed at all external angles. Install flanges or metal collars around the pipes, etc., passing through such box casings, to effectively close and protect all openings. Rat proof the ceiling or flooring over which such casings are built.

(*c*) Wooden casings of the solid box type over pipes, etc., still exist on many ships. Such casings afford excellent living quarters for rats and should be reconstructed at the earliest opportunity on the lines above suggested. Pending reconstruction, the existing casings should be rat proofed by closing all means of ingress with sheet metal. [Drawing 23.]

(*d*) If existing metal protective casings, tubes, ducts, or sleeves fitted over pipes, telegraph, signal, and other communication or electrical leads inclose any space sufficient for rat harborage, see that there are no openings at the ends that would permit rats to enter within the casings, tubes, ducts, or sleeves. If such openings are unavoidable, close them with sheet-metal collars or flashings. [Drawings 24A, 25.]

10. Furniture and Fixtures.

(*a*) Build and install furniture and fixtures in all parts of the ship so as to be free of spaces or features offering rat ingress or harborage. Metal construction is recommended, especially for galley fixtures. If they are made of wood, they should be metal sheathed underneath at points where gnawing might take place.

(*b*) Place galley fixtures away from bulkheads wherever practicable. Eliminate the underneath space by providing suitable solid bases or foundations.

When this can not be done, construct and install them with clear underneath space of at least 10 inches in height. [Drawing 27 and 28.]

(*c*) Construct open settees in preference to boxed seats, but if the latter are required, build them tight, protect the edges around necessary openings for pipes and other leads passing through them with metal collars, and make the lids or covers tight fitting.

(*d*) Flash with metal the inside of the lower section of all wooden wardrobes and washstands. Completely sheathe with metal the sides of all boxed-in spaces in wardrobes, etc., and under settees and berths which are formed by, or are installed against, any unprotected hollow-wooden structure, so as to prevent gnawing into them from the hollow spaces. [Drawings 31, 32, 33, 39.]

(*e*) Build furniture and fixtures in all living quarters, offices, etc., as far as practicable, to rest flat on the deck and tightly to the ceiling without any hollow space in either the base or the top. If this height is not required, make the top sloping to the front so as to be in plain sight and to prevent stowage of anything on it that would afford harborage to rats. [Drawing 29.]

(*f*) Protect the bottom of wooden furniture or inclosures at the deck by suitable metal flashing wherever dead spaces might be reached by gnawing. [Drawings 29, 31.]

(*g*) If the bottom of any furniture or fixture is elevated above the deck and the open space is less than 10 inches high, screen it with perforated metal or heavy-wire mesh. [Drawing 29.]

(*h*) Furniture and fixtures placed against bulkheads or partitions should leave no space, but if such space sufficient for rat harborage is unavoidable, completely close it by substantial filling or by metal angle flashings, to prevent rat ingress.

11. Lockers, Bins, Etc.

(*a*) Construct potato and vegetable bins or crates, also all other bins, cupboards, and lockers of metal in preference to wood, with all parts tight fitting. Equip their doors with closing springs and spring catches. Bed the lockers, etc., directly on the deck or on suitable permanent solid bases. They may be elevated if preferred with clear underneath space of at least 10 inches. If the underneath space is less than 10 inches, inclose it with perforated metal or wire mesh fitted to permit drainage and ventilation and to effectively prevent rat ingress. If the lockers, etc., are built of wood, provide strong, well-made bottoms and fit sheet-metal linings, strips, or flashings wherever gnawing might take place. [Drawings 13A, 30, 35 and 36.]

(*b*) Make cupboards, lockers, and similar inclosures preferably not over five feet high, with tops sloping to front. If more height is required, build them up tightly against the ceiling, avoiding dead spaces. Avoid wide shelves and any feature that would afford rat harborage. Screen or close all unavoidable openings into the inclosures.

(*c*) Build lockers for supplies, tools, etc., in engine rooms or machinery spaces preferably of metal, and avoid as far as practicable locating them in dark and isolated places, in order to facilitate inspection and cleaning and minimize the possibility of undetectible rat harborage. [Drawings 13, 13A.]

(*d*) Screen with wire mesh the inside of crates or similar receptacles installed for the stowage of canvas articles, ropes, etc. Build them with tight-fitting hinged lids and with flush bottoms to rest flat on deck, thus avoiding underneath space. [Drawing 50.]

(*e*) Make metal storage bins for foodstuffs preferably of the garbage-can type with closely fitting covers.

12. Permanent Ballast.

(*a*) If permanent ballast material is stowed in the hold of the ship, under the floor or ceiling and it is not homogeneously cemented in, make its inclosure, including the flooring or ceiling, rat proof.

(*b*) If the permanent ballast material is stowed in independent containers make the latter of thick tongued and grooved or splined planking closely laid, fastened with bolts, and metal bound at all external angles. If any part of the container is not tightly fitted, protect it by sheet metal well secured. Rat proof the ceiling or flooring which is to be occupied by any ballast container. [Drawing 7.]

(*c*) Where there is possibility of rat ingress into a closed ballast compartment or container, any vacant space and the voids in the ballast component, if sufficient to afford rat harborage, should be filled with suitable material such as finely crushed rock.

13. Temporary Inclosures.

The construction of temporary inclosures erected for stowage of berths, mattresses, life preservers, etc., should be such that when in place all sections fit snugly together and against the ship's structure so as to prevent ingress of rats. The materials used in such construction should be rat proof or properly metal protected against gnawing at edges of sections, base, top, and corners. [Drawing 18, composite cross section.]

14. Rat Proofing Ships in Service.

(*a*) Examine all wooden flooring and limber boards. Repair or replace broken and defective boards so as to make all tight fitting.

(*b*) Screen all open spaces at the ship's sides between the inner bottom tanks and the floors of holds with heavy-wire mesh or galvanized sheet metal perforated for drainage and air circulation, the perforations not to exceed one-half inch.

(*c*) Replace all box type wooden casings over pipes, electrical and other leads, etc., by an open type of protective casing similar to the optional types specified in section 9.

(*d*) If wooden box casings, either vertical or horizontal, must be temporarily retained see that they are cleaned out, then repair or replace all defective boards so as to make them tight from deck to ceiling. If the ends do not extend to the deck or ceiling, close such openings with sheet-metal flashings. If they extend to the deck and ceiling, protect the bottom and the tops against gnawing with sheet-metal flashing not less than 6 inches wide. Wooden-box casings must be frequently inspected and kept in good condition in order to effectively prevent entrance of rats.

(*e*) Install sheet-metal flanges or collars on all pipes passing through decks and bulkheads so as to close all openings around them through which rats might pass. This should be done before making the box casings tight. If such collars are already fitted, see that they are in proper order.

(*f*) Examine all doors and repair them where necessary to make them rat tight. Protect the bottoms of wooden doors and thresholds with sheet metal against gnawing.

(*g*) Inspect all lockers, bins, closets, cupboards, etc. Replace them with new construction as specified in section 11 where bad conditions are found.

Where old construction is retained, repair all defects. Eliminate all hollow bottoms and tops. Replace flat tops on those that do not extend to the ceiling with tops sloping to the front so that they are in plain sight and are unusable for stowage of anything that would give harborage to rats. In cases where this can not be done, close the spaces effectively against rats by heavy-wire mesh or sheet metal. Close similarly any space less than 10 inches under the bottom. Make all doors tight fitting and fit them with spring catches. Fit metal flashing around bottoms of all wooden closets or lockers.

(*h*) Inspect all boxed seats or settees. If not already fitted with lids or covers, reconstruct so as to provide them. Sheathe with metal the interior of boxed-in spaces against hollow wooden ceiling or partitions. Close with metal collars all openings around pipes and other leads penetrating such spaces.

(*i*) Inspect the forepeak and afterpeak spaces. If practicable, discontinue their use for stowage of boatswain's or other deck stores. If this is not practicable, remove and overhaul the materials, segregate them into appropriate lots, and restow them in open manner as far as practicable.

(*j*) Inspect all wooden partitions, particularly as to their tightness along floors, sides, and ceilings. Repair all defects and cover all holes and open joints with sheet metal. Close with sheet metal all openings around beams, pipes, etc., passing through them. Protect both sides of hollow partitions at the edges where gnawing might take place with sheet-metal flashing.

(*k*) Close with well-bordered wire-mesh or perforated metal panels all openings left over partitions for ventilation such as between beams, etc., the panels to fit neatly.

(*l*) Inspect all hatch covers and replace or repair any broken or defective parts until they fit tightly. Screen the underside of hatch gratings which are not otherwise rat proof.

(*m*) Where practicable, replace wooden bins in provision storerooms and galleys with metal ones, preferably of the garbage-can type, with tight covers. If wooden bins must be retained, line them with metal and see that the covers close tightly.

(*n*) Inspect doors to storerooms and galleys and make them tight fitting. Equip all main entrance doors with substantial closing springs. Cover wooden thresholds, door frames, and the bottoms of wooden doors with sheet metal.

(*o*) Inspect ceilings in holds. Make them tight and protect all edges and joints with sheet-metal strips as specified in section 3. Install similar flashing around stanchions, structural columns, web frames, pipes, etc., passing through the ceiling.

(*p*) Inspect all permanent ballast. If found to contain rat harborage, or opportunity therefor, restow the ballast in rat-proof containers as specified in section 12.

(*q*) Provide means for prompt and safe disposal of all food waste and refuse.

15. Materials and Workmanship.

(*a*) Screens over partitions, also for doors, skylights, and places where rough usage is likely, may be of any of the following materials:

(1) Sheet metal of not less than No. 18 United States gage with punched perforations, the openings not to exceed one-half inch.

(2) Woven wire or metalace, made of No. 14 American gage wire, the mesh not to exceed one-half inch.

(3) Expanded metal of not less than No. 18 United States gage, with openings not larger than one-half inch.

(*b*) The screen materials should be well bordered, anchored to the border, and secured to the surrounding structure by bolts or screws, using metal lugs where necessary.

(*c*) If the screens are installed with wooden frames or molding, the metal should extend to the outer edge of the frame.

(*d*) Sheet metal for flashings, covering strips and patches, and for collars around pipes and structural parts should be of thickness not less than No. 18 United States gage for the lightest work, thicker metal to be used where subject to damage or corrosion, all to be securely fastened, preferably with bolts or screws.

(*e*) All corrodible metal should be galvanized or otherwise suitably coated.

(*f*) every part installed for rat proofing must be substantial, closely fitted, and thoroughly fastened, using bolts or screws wherever practicable.

(*g*) The type and degree of finish required for any part of the work depend upon the location and the character of the adjacent work. This should be defined in ordering the work.

16. Operating Requirements.

(*a*) The benefit of rat proofing or of initial rat eradication, irrespective of the thoroughness with which it may have been accomplished, depends upon the condition in which the ship is thence maintained and operated. General cleanliness, isolation and prompt disposal of refuse and orderly stowage of ship's stores and gear are essential. Those in responsible authority for the condition of the ship and prevention of rat infestation must be relied upon to issue and enforce proper operating regulations. The following are mentioned as foremost requisites:

(1) Garbage and other refuse attract and afford harborage and sustenance to rats. Material of this character which accumulates while the vessel is in port, should, therefore, be promptly disposed of and not allowed to accumulate. If practicable, it should be consumed in the ship's furnaces at frequent intervals. If this is not practicable, portable rat-proof containers of sufficient aggregate capacity should be provided. Such containers may be of the crate type if properly constructed and completely screened, including the top or lid and with the bottoms so built that the edges rest flat on the deck, leaving no means of access underneath. The tops should be tight fitting.

(2) All loose food supplies should be kept as constantly as practicable under rat-proof covers, especially at night. Before the mess crews go off duty they should inspect galleys, mess rooms, and other places where foods and loose supplies are handled and remove all scraps.

(3) The stowage or consumption of foods in crews' quarters should be prevented as far as practicable. If such must be allowed, strict regulations should be enforced to keep all supplies in rat-tight containers and to immediately remove all scraps.

(4) Hatch covers and gratings should be kept in place as far as practicable.

(5) All service doors and deck openings should be kept in tight and proper working conditions.

(*b*) As a matter of precaution, ships' officers and personnel should be urged to observe and report anything indicating the presence of rats, also any places that in their judgment might afford rat harborage, giving particulars of condition and location.

Index to Key Plan

The index to key plan is intended to show typical examples of structural or incidental defects that are responsible for the usual rat harborages found on board of vessels.

1. *Ceiling over tank top and bilges.*—Rats harbor and nest in space between tank top and ceiling, gaining entrance to same through openings in ceiling boards around frames, pillars, pipes, bulkheads, sides of ship, and bilge covers.

2. *Opening between tank top and ceiling at margin plate.*—When limber boards are left off for any considerable period of time, rats make use of such openings to get to the harborage in the space over the tank top.

3. *Pad or platform on tank top under hatch openings.*—When platforms or pads are built on risers several inches high, the inclosed spaces beneath afford harborage for rats.

4. *Spaces between structural frames at ship's side, lower hold.*—The spaces are usually closed by light wood fillers jammed between the frames and covered with a thin cement slab or wash. This thin layer frequently cracks, gets broken, and crumbles, creating holes and openings through which rats pass into the spaces in the bilges, etc.

5. *Sheathing under deck head in lower holds and between deck spaces.*—Rats gnaw holes in this type of sheathing at the margins and angles, and also around pipes, frames, etc., or use the accidental openings which are already in existence to get into the inclosed and insulated space overhead where they find excellent harborage.

6. *Wooden bulkheads or sheathing over water-tight bulkheads in holds.*—Harborage is found in the space between the wooden bulkhead and the steel water-tight one, they being separated by 10 or 12 inches. Access to harborage of this class is very similar to that described under No. 5.

7. *Stowage for permanent ballast in holds.*—The usual crib housing or floor boards used to cover ballast is so open that it is easy for rats to get into such inclosures and nest and breed in the spaces between the ballast itself or on top of same. Even when the wood housing is fairly tight rats will gnaw holes in same at the edges or corners if not protected by metal flashing.

8. *Wooden sheathing in air cooled and insulated cargo holds.*—The spaces between the sheathing and the skin of the ship, water-tight bulkheads and deck head afford abundant harborage for rats. They get into such spaces through openings around frames, pillars, pipes, etc., which in many instances have been gnawed by the rats themselves.

9. *Foundations for pillars.*—Lightening holes in certain boxed types of pillar foundations offer entrance to the rat harborage contained therein.

10. *Pillar supports under deck.*—The wide shelf-like plates installed on the tops of certain types of pillar supports are used by rats for hiding and nesting. The structural beams that rest on the tops of these pillars offer the ready means of communication to this harborage.

11. *Arrangement of storage facilities in forepeak.*—The mass storage of old supplies, ropes, canvas, etc., provides harborage for rats and since many of these supplies are not handled for long periods, nesting and breeding may go on undisturbed.

12. *Forepeak hatch.*—Is usually covered with a wooden grating, the openings of which are generally so large that rats pass through with ease and get into forepeak and nest and breed in the boatswain's stores as described in No. 11.

13. *Engineers' storerooms.*—When supplies are stored in quantities, and the inclosure is not protected by close fitting ½-inch mesh, rats get into the storerooms and find harborage in the stores.

14. *Lockers.*—Are used for harborage and hiding places unless properly built and installed. In most cases there are openings in the inside of lockers which communicate directly with inclosed spaces in deck head or ship's side permitting access to harborages in such places.

15. *Shaft alley—Recesses used as storerooms.*—Harborage usually found in bulk supplies stored in wings and kept in bins or boxes that are not rat proof.

16. *Entrances and escapes from shaft alley.*—Permit rats to get into shaft alley through absence of proper kind of rat-proof gratings or covers to escapes.

17. *Insured cargo spaces—Mail and baggage room.*—The open-type wooden spar inclosures used in such compartments permit rats to gain easy access to and hide under the floor gratings, casings, or overhead vents.

18. *Storage for sundry equipment including life belts, berths, bunks, mattresses, etc.*—The mass storage of these supplies and equipment in the between deck spaces for months at a time affords convenient harborage among the equipment itself. Portable rat-proof bulkheads should be placed around same to prevent rats from getting into such supplies.

19. *Refrigerated spaces.*—Harborage is in the insulated space between the inner and outer shell or sheathing and is reached generally through unprotected openings around pipe lines, beams, etc., where rats enter the refrigerators. Rats also gnaw holes in the shells if not metal lined or metal flashed at tops, sides, and bottoms.

20. *Provision storerooms.*—Rats harbor, nest, and hide under and in backs of badly designed and poorly located bins, shelves, and lockers, also under old types of raised floor gratings, behind sheathing on outboard side, and in the bulk stores themselves when there are stores in mass heaps and remain undisturbed for long periods.

21. *Potato holds.*—Defects in potato holds or bins consist almost entirely of too large openings between the ventilating gratings or louvres which permit rats to pass easily into same. The absence of wire screen or other metal protection to the wooden gratings makes it easy for rats to gnaw and enlarge any opening which they may find necessary.

22. *Vertical pipe casings—various types.*—The vertical boxed casings afford protected and completely hidden harborage and nesting places for rats. The inclosed pipe serves as a stairway and permits them to run up and down and select the flange of the pipe or interior brace or strap on which to locate their nests. The pipe also serves, in many instances, as a means of through communication to the other decks above or the space between the tank top and the ceiling in the lower hold. When the usual incidental openings in boxed casings are lacking the rats make them by gnawing.

23. *Horizontal pipe casings—various types.*—The horizontal boxed casings, because of their tunnellike construction, area, and accessibility, offer commodious homes and breeding places for rats. They get into such casings through openings around the pipes, etc.

24. *Under-deck pipe casings—various types.*—The trough-like casings which are constructed to give protection to the pipes and pipe lines installed under deck heads are preferred for homes by the species of rats usually found on ships. These overhead casings are several inches deep, and are generally open at the top. They not only offer the rat a protected and concealed harborage but give him every opportunity to observe the movements of his enemies and

to see what is going on without himself being seen. The structural girders which cross these casings every few feet provide excellent runways and means of communication for rats living therein.

25. *Casings for cables, signal wires, etc.*—Have harborage very similar to that mentioned in No. 24.

26. *Screen bulkheads around galley spaces or sections.*—If of the usual large open-mesh type, with openings over the top and raised several inches from the floor, they will not prevent rats from getting into such places, and therefore are useless for this purpose.

27. *The overhead insulation and the inclosed spaces on ship's side in galleys, pantries, etc.*—The overhead space which is usually filled in with cork or other insulating material and the space behind the wooden sheathing on the outboard side of the ship are frequently used as harborage and nesting places. Unprotected openings around beams, hanger straps for air ducts, pipes, etc., in the deck-head sheathing, are used by rats to get into such insulated spaces.

28. *Galley fixtures, work tables, dressers, lockers, etc.*—When such fixtures are installed against bulkheads and ship's sides and are built with inclosed lower sections or fitted with rows of drawers, rats find harborage in the dead space in these places and also nest in the old material which is stored therein.

29. *Refrigerators and ice boxes.*—Typical harborage around refrigerators has been described under No. 19. The tops of galley refrigerators, however, provide additional harborage in the mass of utensils, bags, boxes, etc., frequently stored thereon for indefinite periods.

30. *Stewards' lockers including lockers or closets under stairways, etc.*—Lockers, owing to their inclosed character and the crowded manner in which the supplies are usually stored therein, are generally rat infested, usually access to same being by way of overhead and other openings found in the interiors of the lockers.

31. *Wardrobes and settees on outboard side.*—Harborage in wardrobes is usually found in the dead space under the bottom drawer, access to which is through the open space in the back of the wardrobe where it adjoins the outboard sheathing and which, in many cases, is not finished to the floor level. In the case of settees, harborage is in the dead space in the boxed foundation or in the adjoining space between the panel sheathing and the skin of the ship.

32. *Washstands.*—The inclosed bases of washstands and the boxed casings over supply and waste pipes furnish harborages. Rats get into same through the openings around pipe lines.

33. *Lockers under officers' berths.*—Harborage and the manner in which rats get into same is practically identical with that described in No. 31 for settees.

34. *Screens and covers over radiators and heater pipes.*—Spaces back of screens and covers over heater pipes, are used as runways and temporary hiding places by rats. The slots or perforations larger than one-half inch in the sheet metal coverings as well as openings at the ends and at junction of sections, permit them to enter same with ease.

35. *Lockers in passageways.*—Harborage same as described under No. 30.

36. *Linen lockers and closets.*—Harborage same as described under No. 30.

37. *Typical stateroom section.*—Harborage in staterooms may be dead spaces in the inclosed spaces on the outboard side, in the overhead deck space or in the bases or bottoms of wardrobes, dressers, etc. Accidental openings around pipes, beams, etc., and in the bases of outboard sheathing (the result of unfinished work) make it possible for rats to get into such places.

38. *Toilets and baths.*—Openings around pipes, beams, etc., in bulkheads or partitions of bathroom and toilet inclosures permit rats to get into such places and obtain their water supply and also to hide.

39. *Settees in public rooms.*—The harborage under settees in public rooms is similar in character to that described under No. 31.

40. *Window casings in superstructure.*—When not properly constructed and sheathed, rats use the openings in the casing frames to get into the staterooms, etc., from their harborage in the inclosed spaces in the ship's side.

41. *Gangway ports for passengers and crew.*—Openings in the deckhead and in the inclosed space between the inner panels and the skin of the ship on the outboard side in and around the frames of these side ports, permit any rats that may come aboard at night via the gangway immediately to enter into such spaces, conceal themselves and make use of the excellent harborage afforded therein.

42. *Air-duct supply openings.*—Air-duct openings if not properly screened allow rats to get into these air lines and to use the entire system in that section as a concealed runway and means of communication to all parts of the ship served by such trunks.

43. *Air-duct lines.*—Are used more as a means of communication and temporary hiding place than for permanent harborage or nesting. Duct lines that run parallel with and alongside of overhead beams, form tunnel-like inclosures which are excellent harborages.

44. *Torpedo or T-shaped ventilators to deck houses.*—When the openings in such ventilators are not properly protected, rodents may get into the rooms of the superstructure from the outside through same. This is possible, of course, only when a pipe-line or electric conduit runs parallel with and adjacent to these outside ventilators, providing the means of reaching the ventilators.

45. *Blowers.*—Not a very serious menace, but may be used by rats to enter ship from the top side.

46. *Cowls.*—Rats have been known to enter vessels through the unprotected openings of cowls, but such instances are rather rare.

47. *Fan lights.*—Frequently used by rodents to enter and escape from living quarters in the superstructure.

48. *Skylights.*—Same as No. 47.

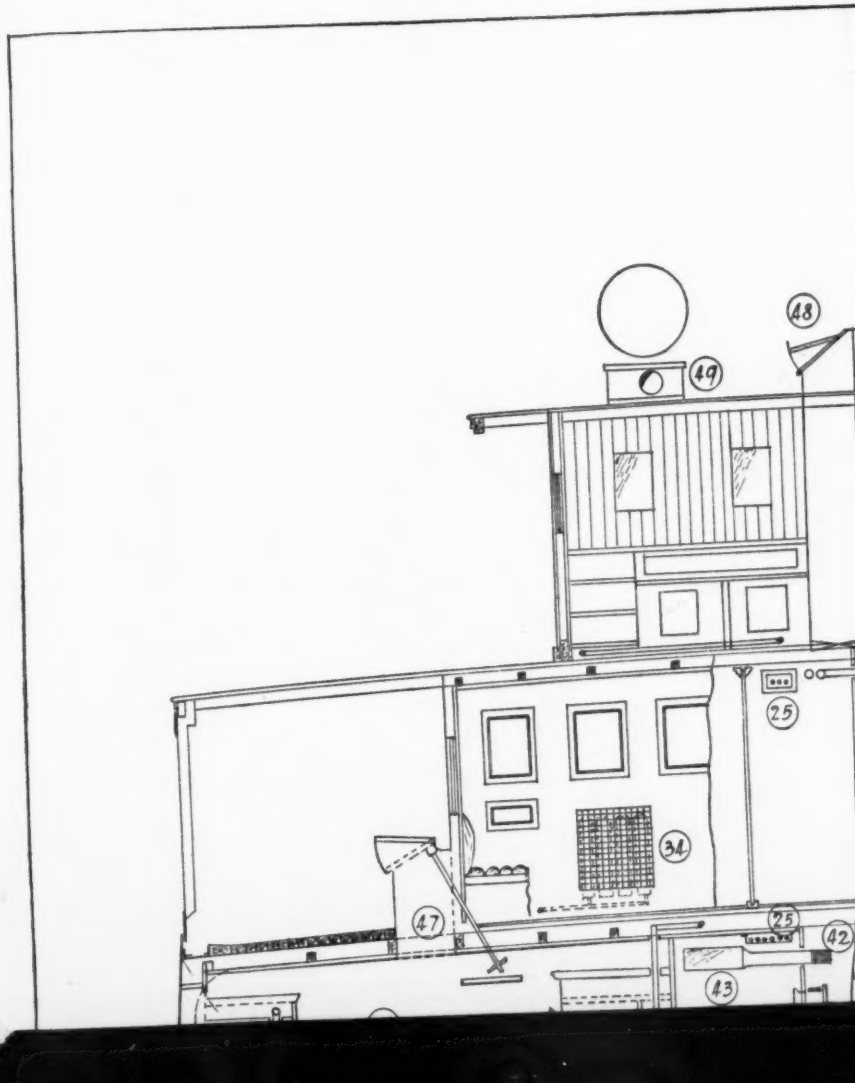
49. *Motor bases.*—The lightening holes in the bases or foundations of motors, etc., allow easy access to the dead space in these box-like inclosures, where rats may avail themselves of excellent harborage.

50. *Life-belt boxes, etc.*—Harborage is in the box itself and its contents. Access is had by means of ventilation openings incident to style of construction of box or holes gnawed from underneath.

51. *Fire-hose lockers.*—Lockers used for this purpose are usually recessed and are located in the passageways. The water supply pipes, which have their outlet in such lockers, pass through inclosed spaces overhead or on ship's side, where harborage exists. Unless the frames and panels of the lockers have been properly fitted and protected with flashing and the openings around the pipes have been fitted with collars, these openings will be used by rats to get into the overhead spaces.

52. *Electric-light switchboard boxes.*—Conditions described under No. 51 are found to exist also in these boxes. Many openings due to poor and improper fittings, both in and around the boxes, permit rats to get into deck-head spaces and use the electric trunk lines as a hidden means of communication to reach other sections of the ship.

53. *Electric stations.*—Same as described above, except that being large and located in more out-of-the-way places, they are used by rats to a greater extent.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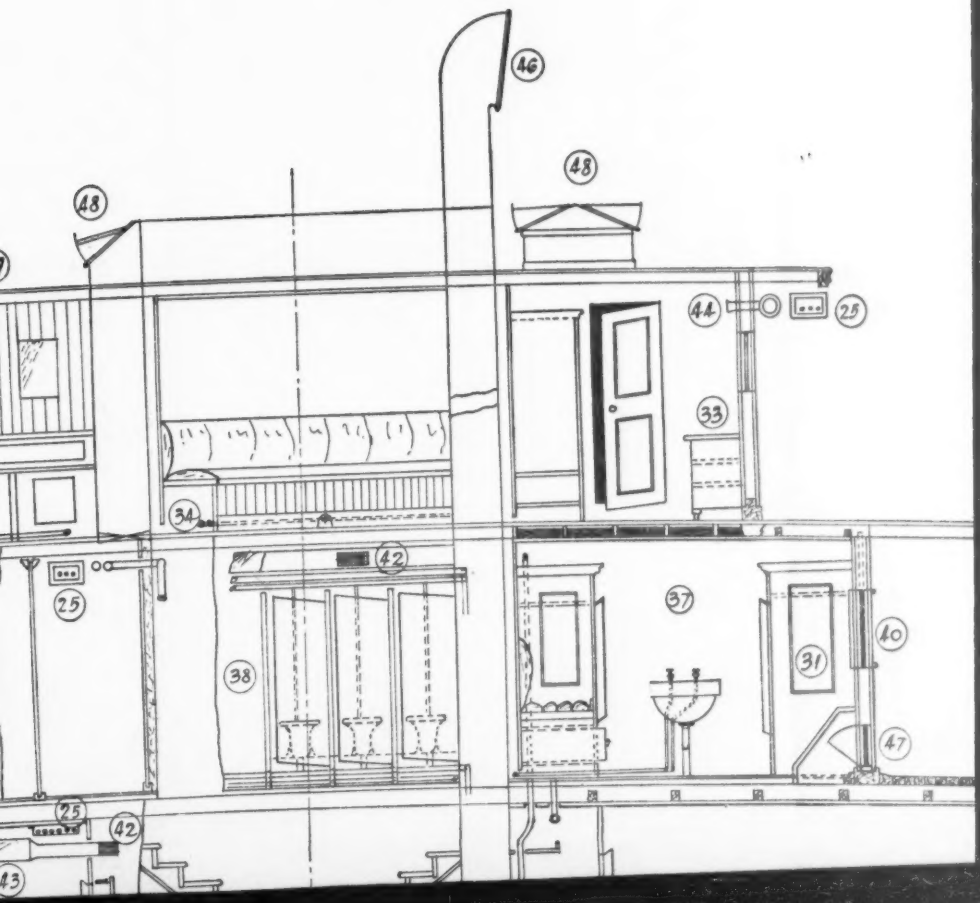
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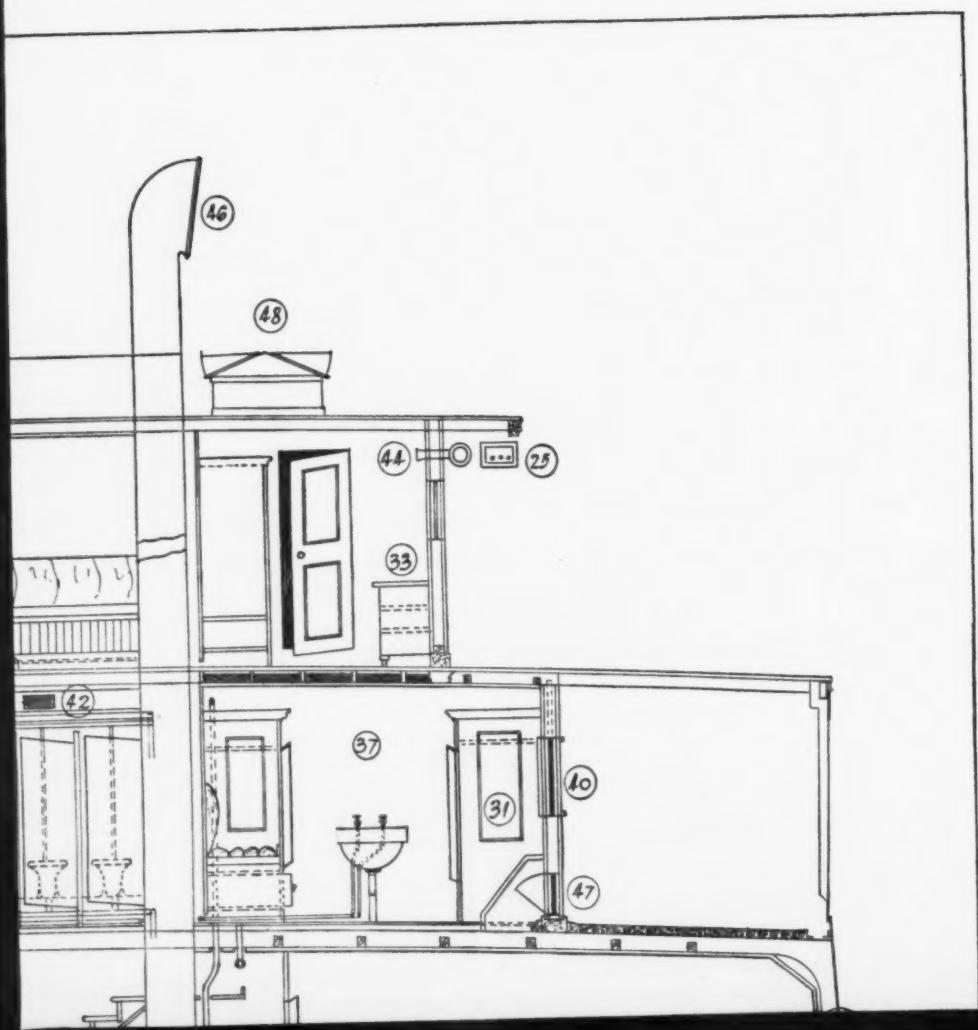
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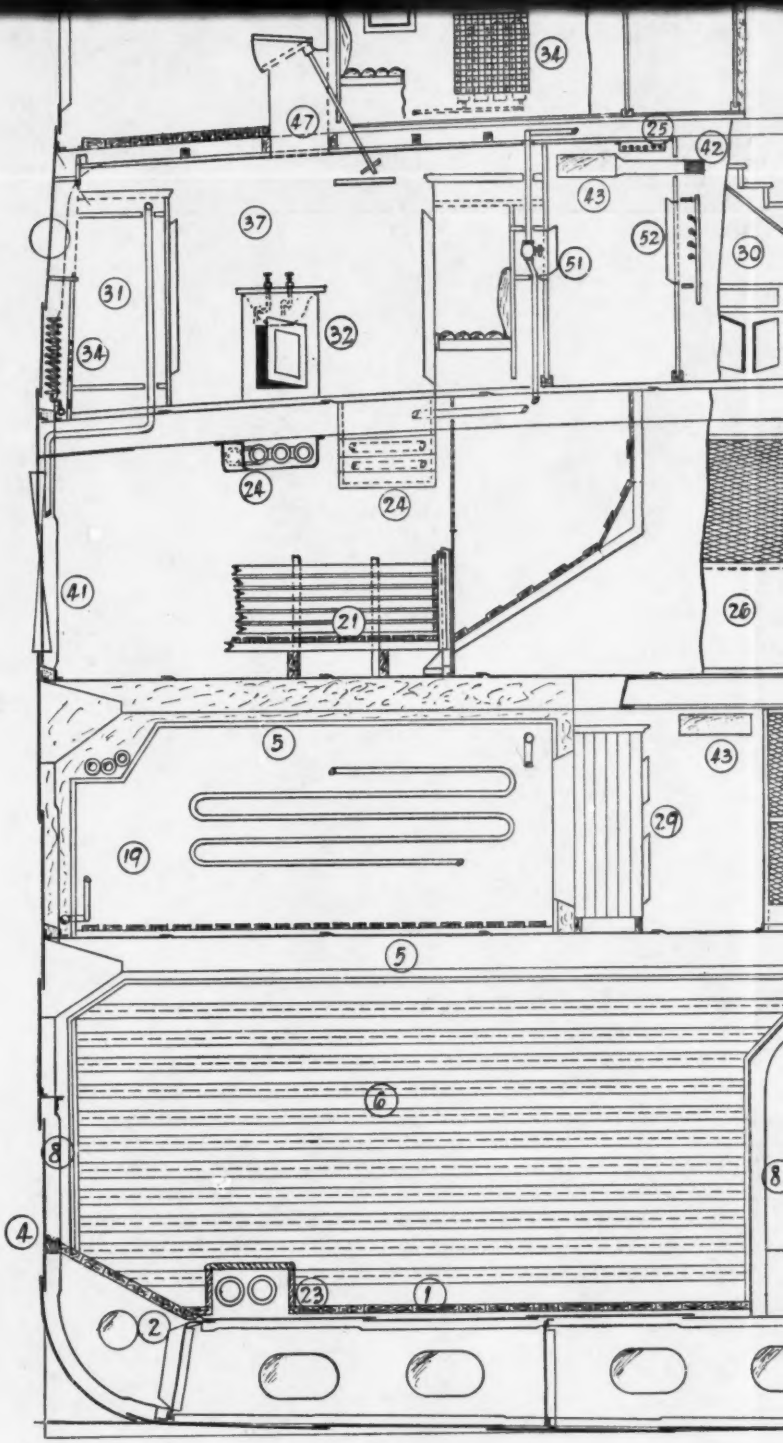

NOTE:- SEE INDEX TO KEY PLAN FOR DETAILED EXPLANATION

SHOWING TYPICA
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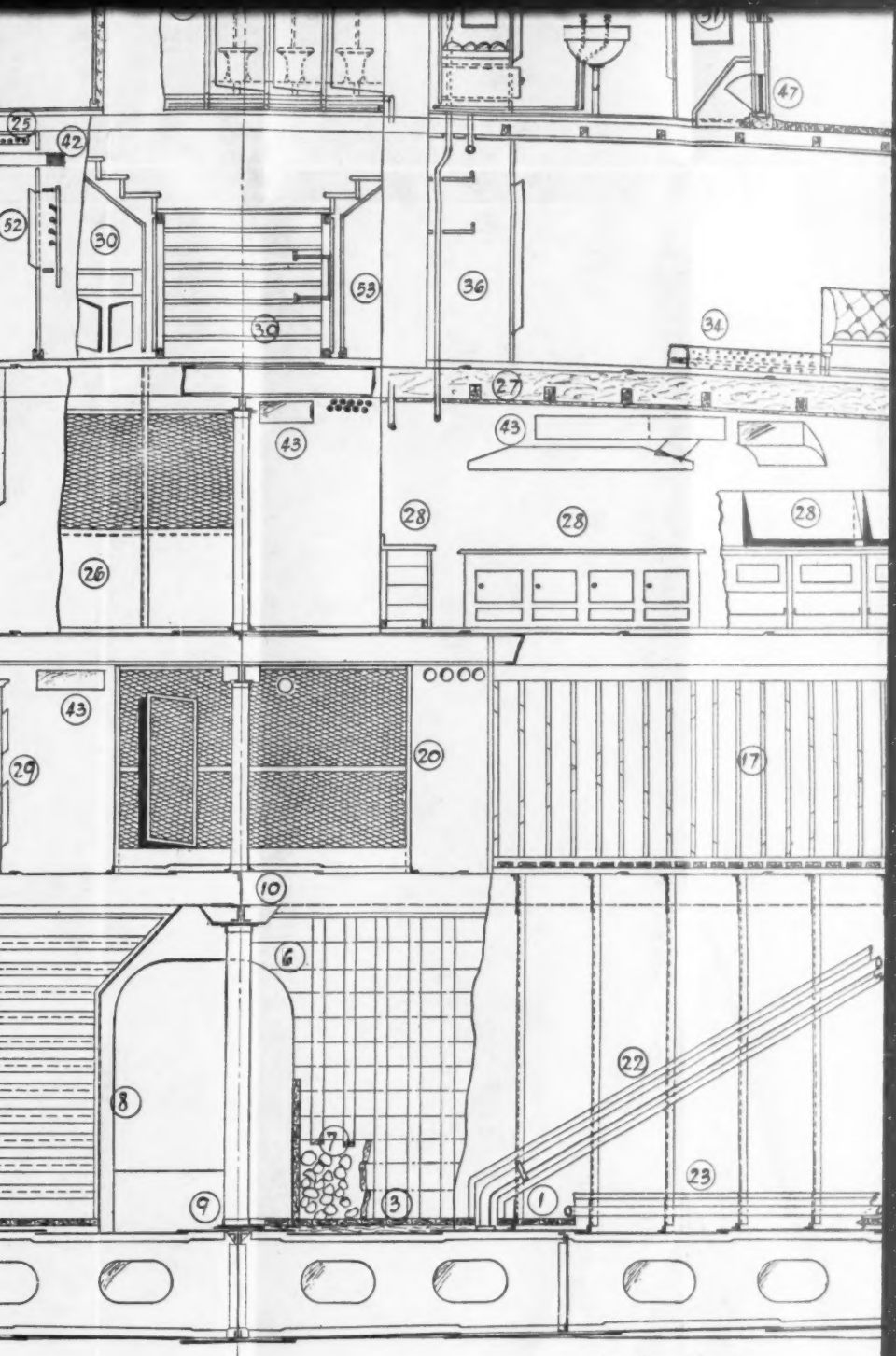

KEY PLAN

ING TYPICAL EXAMPLES OF STRUCTURAL OR
ENTAL DEFECTS THAT ARE RESPONSIBLE FOR
HARBORAGE USUALLY FOUND ON VESSELS

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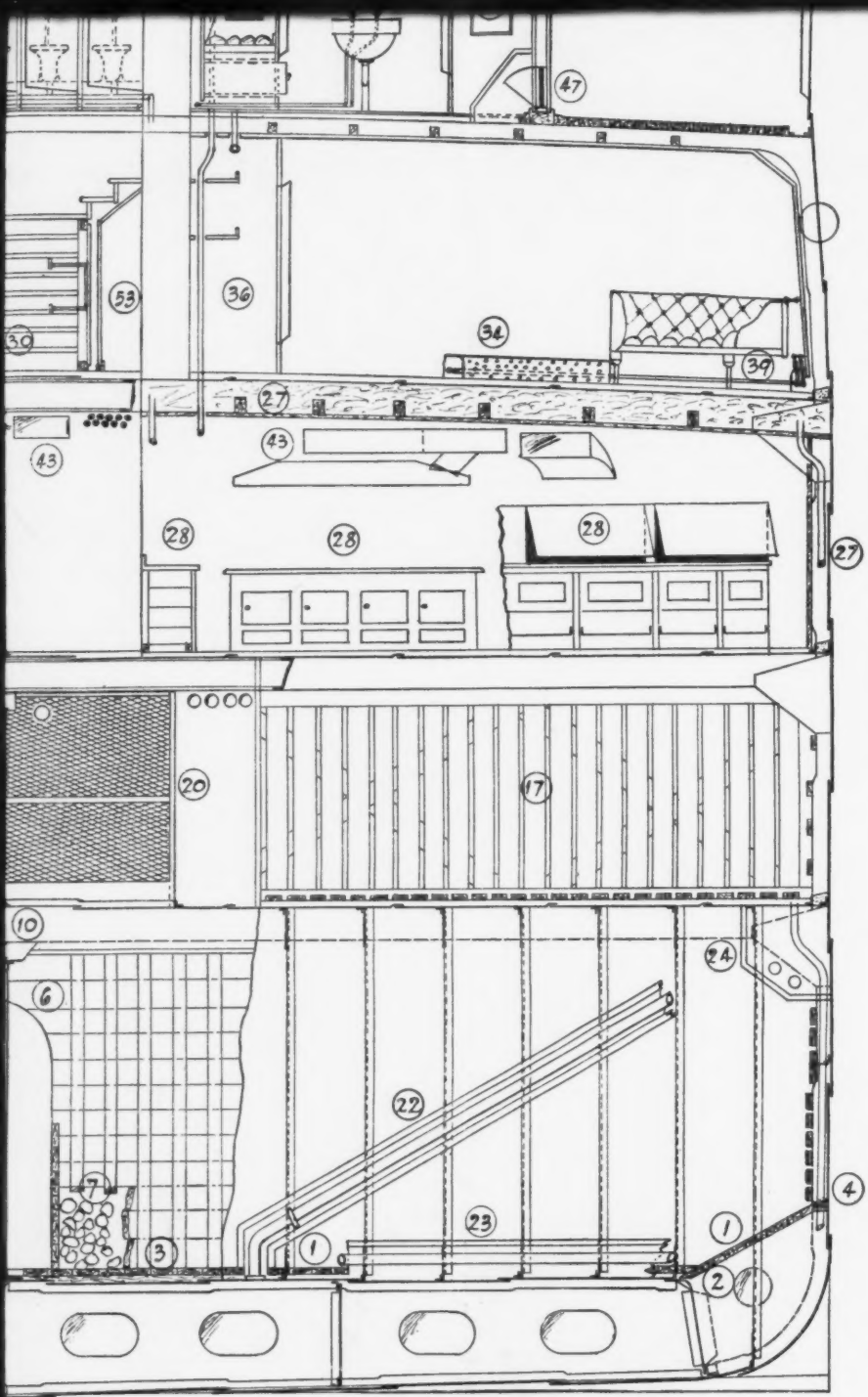
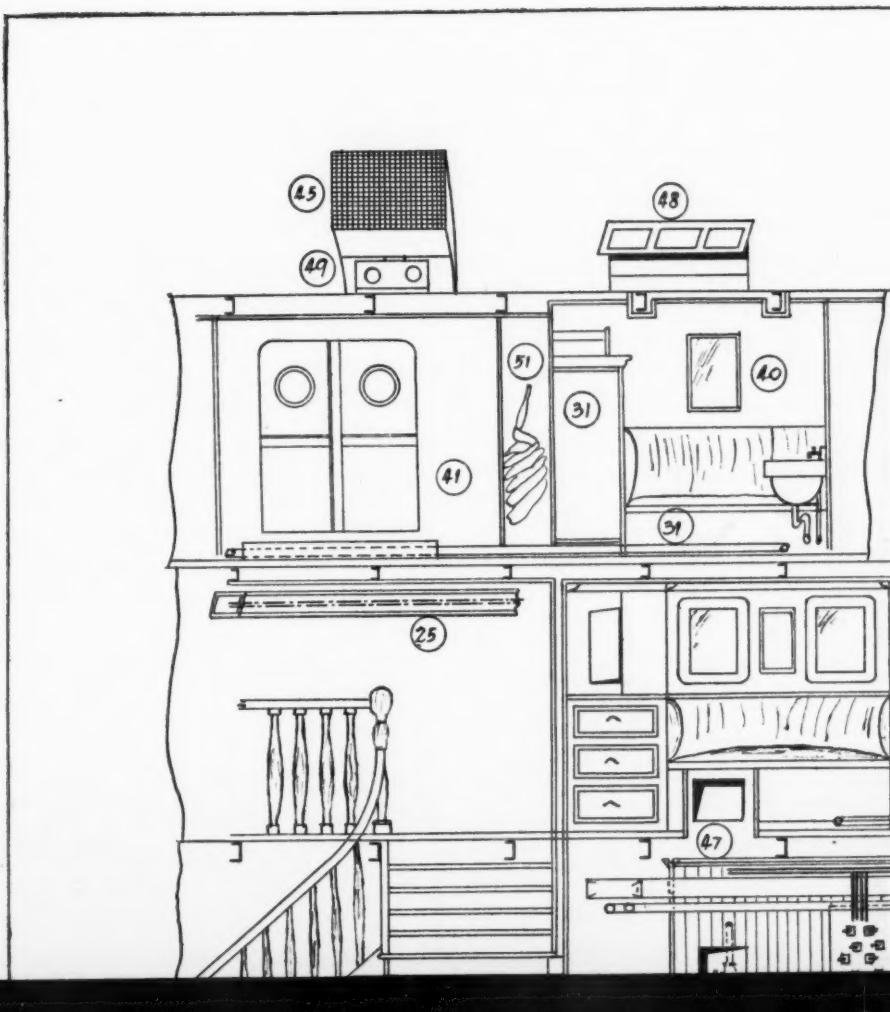
12. Fore Peak Booby Hatch
13 Engineers Store Room
14. Lockers in Engine Roo
15. Shaft Alley
16 Entrances & Escapes, S



PLAN
OF STRUCTURAL OR
ARE RESPONSIBLE FOR
FOUND ON VESSELS

11 Fore Peak
12 Fore Peak Booby Hatch
13 Engineers Store Rooms
14. Lockers in Engine Room
15. Shaft Alley
16 Entrances & Escapes, Shaft Alley

U.S. PUBLIC HEALTH SERVICE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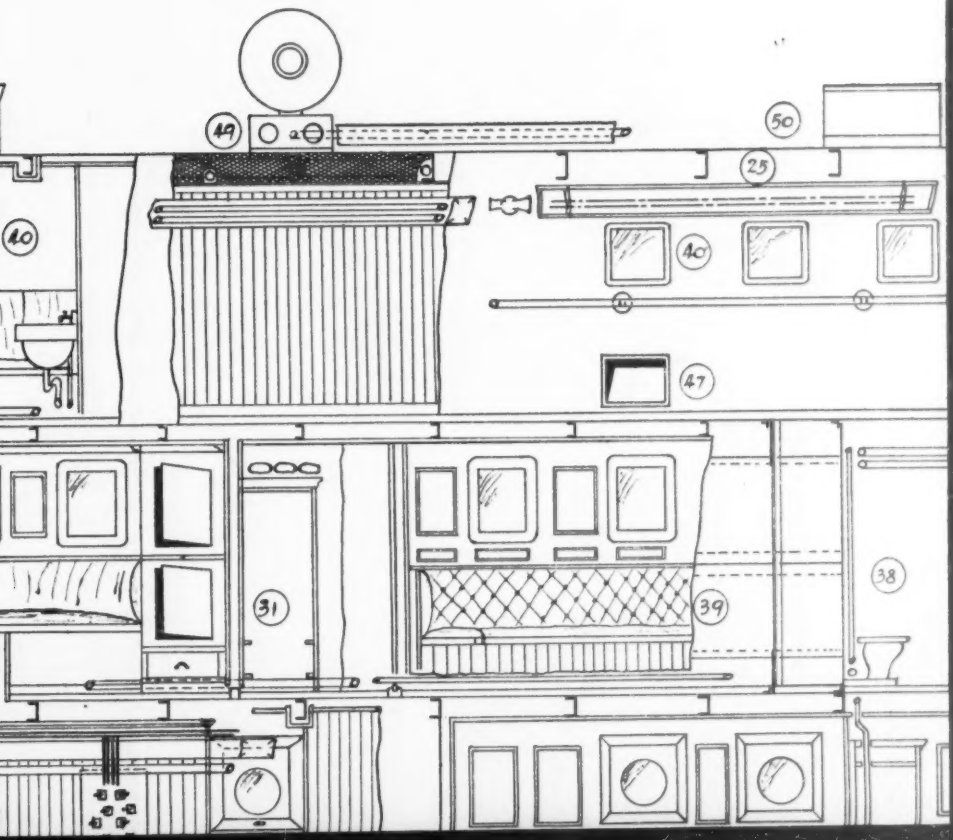
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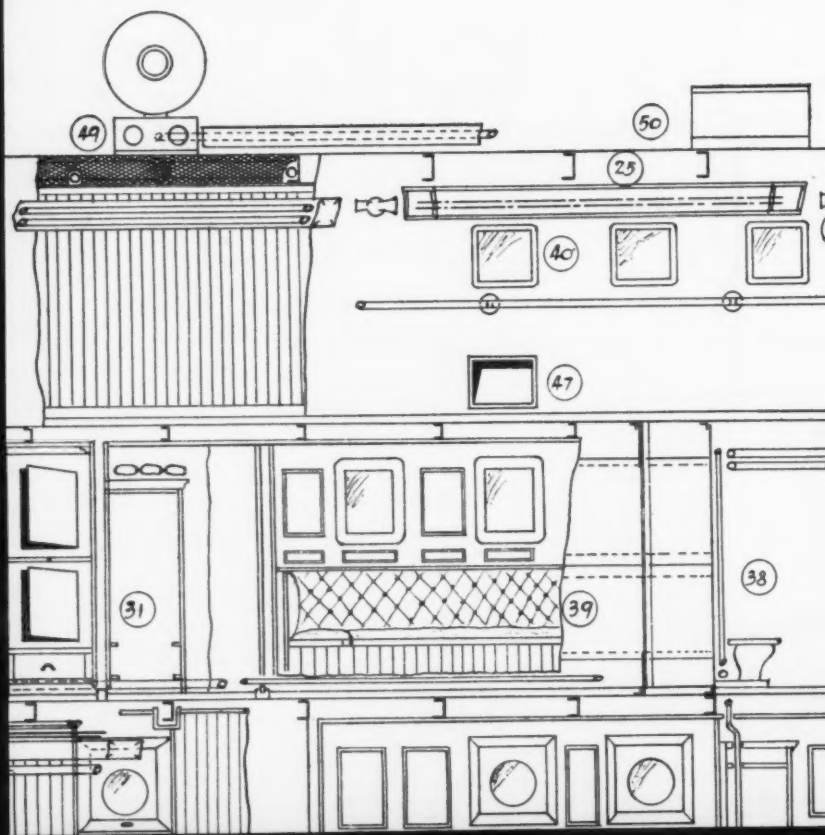
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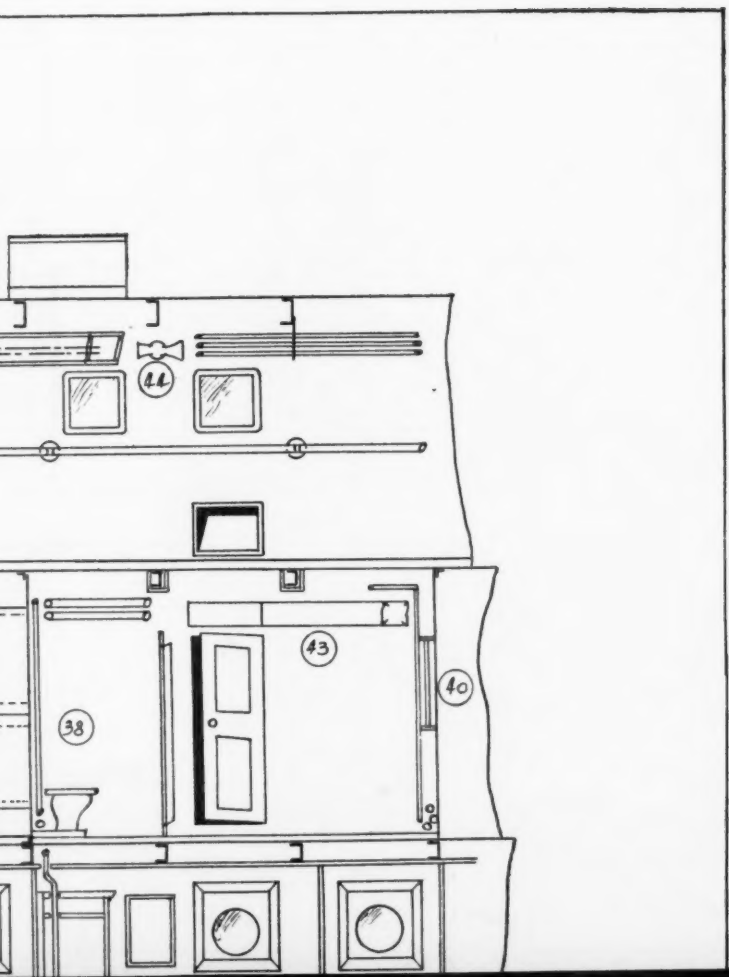
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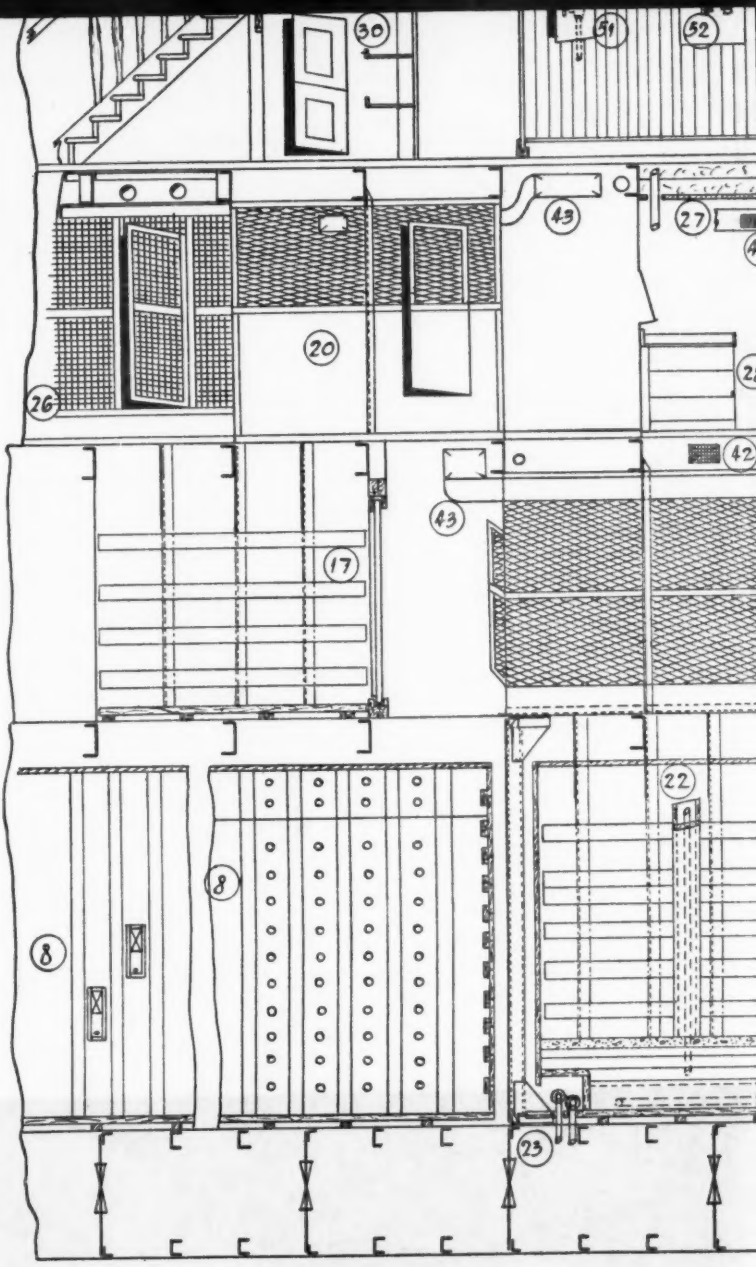
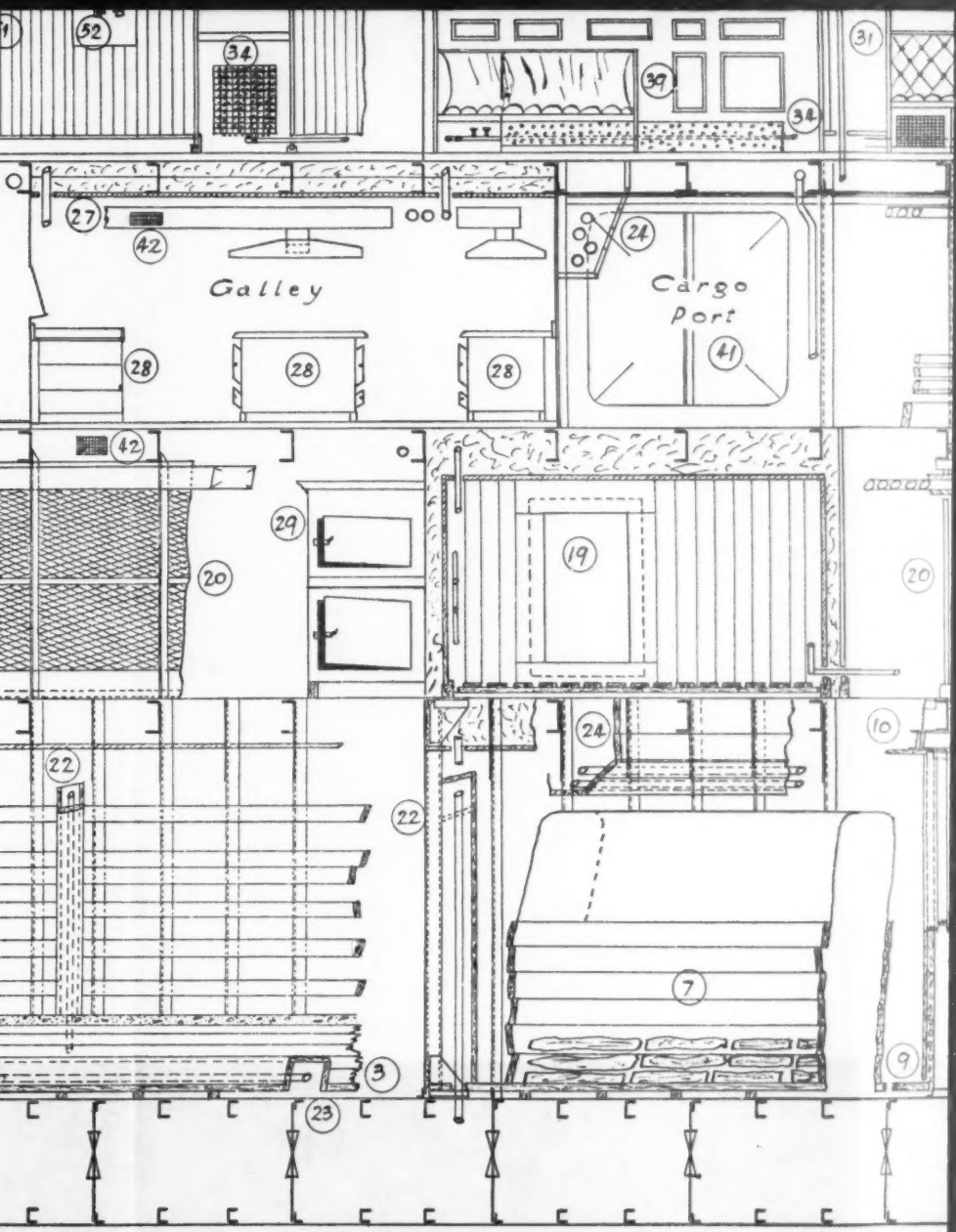
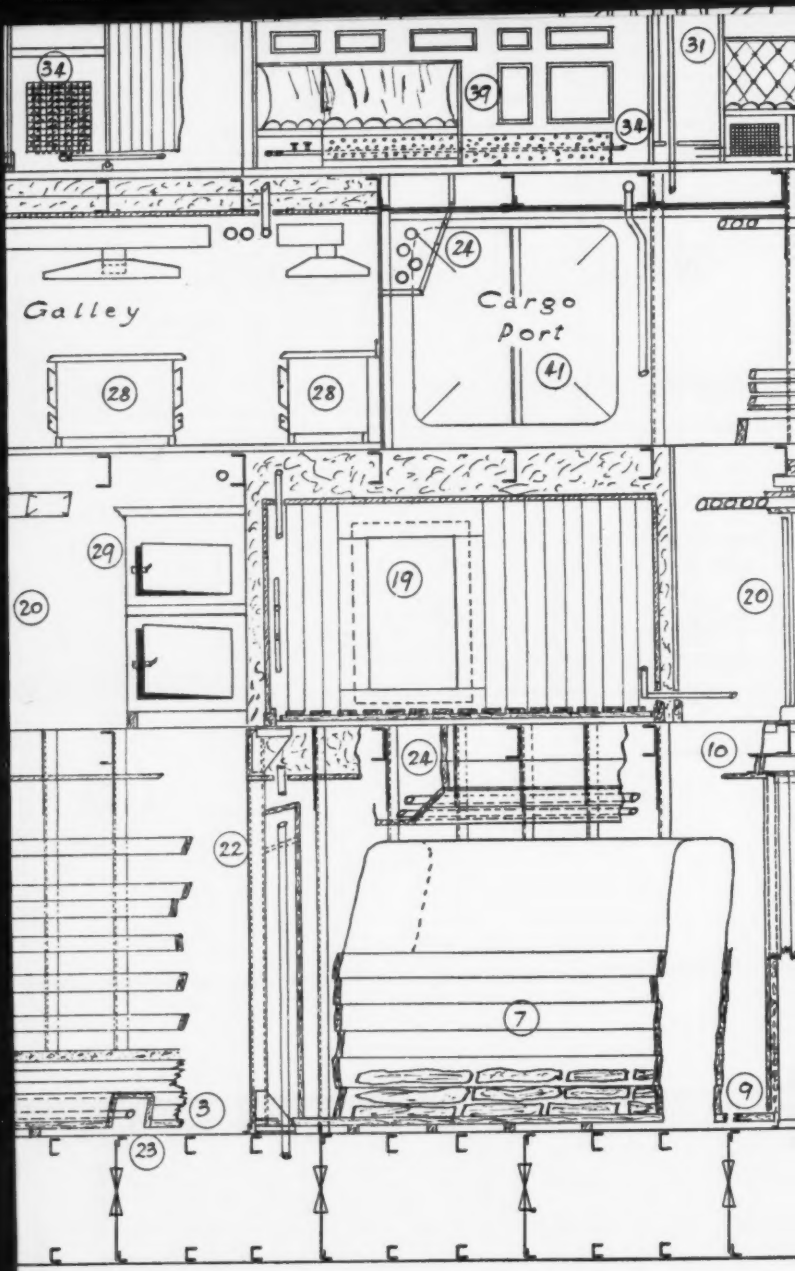

30
51
52
43
27
20
26
42
43
17
22
8
8
23



KEY PLAN

TYPICAL LONGITUDINAL SECTION

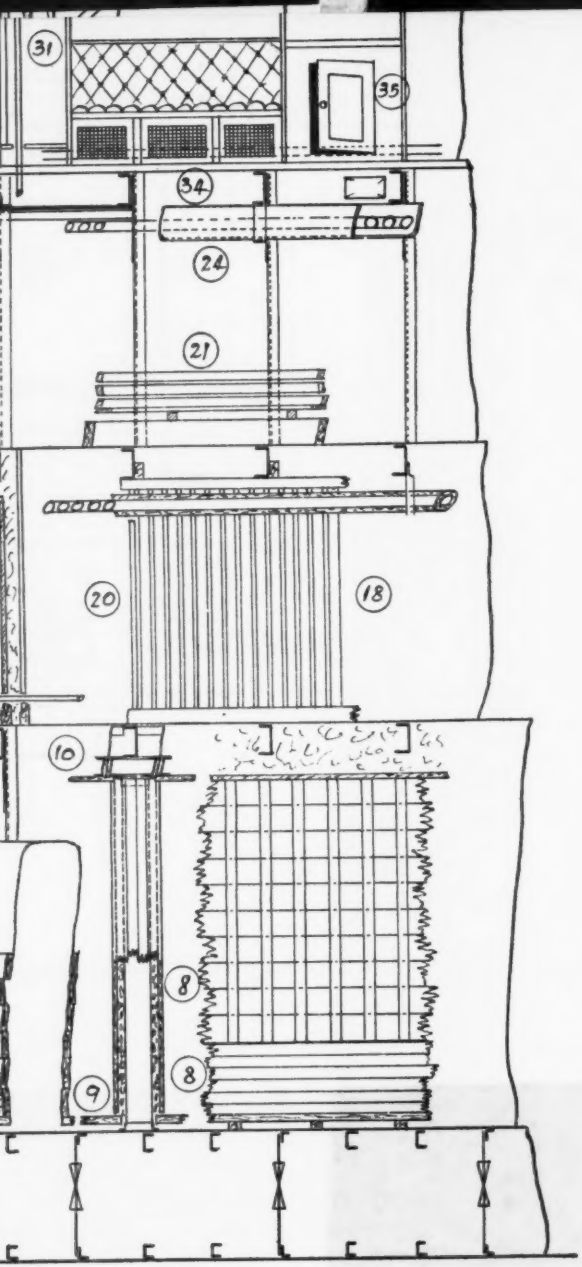
NOTE :- SEE INDEX TO KEY PLAN FOR DETAILED EXPLANATION



KEY PLAN

AL LONGITUDINAL SECTION

E:- SEE INDEX TO KEY PLAN FOR
DETAILED EXPLANATION



U.S. PUBLIC HEALTH SERVICE.

45507°—31. (Face p. 32.) No. 2.

MEMORANDUM REGARDING THE ABSENCE OF CERTAIN NUMBERS OF THE SET OF DETAIL TECHNICAL DRAWINGS

No. 14. There is no detail drawing of this number, inasmuch as the drawings Nos. 30, 35, and 36 cover these subjects and give general typical methods of eliminating harborage in lockers.

No. 16. Entrances and escapes from shaft alley. The correction of these conditions is shown on drawing No. 15, the subject of treatment of shaft alley being covered in this one drawing.

No. 18. Storage for sundry equipment, including life belts, berths, bunks, mattresses, etc. No drawing was made to cover these portable bulkheads, as the drawings under No. 37B–B showing typical stateroom sections are representative of the work which should be done in order to make rat proof bulkheads or partitions recommended to be installed around inclosures enumerated under No. 18 of the index.

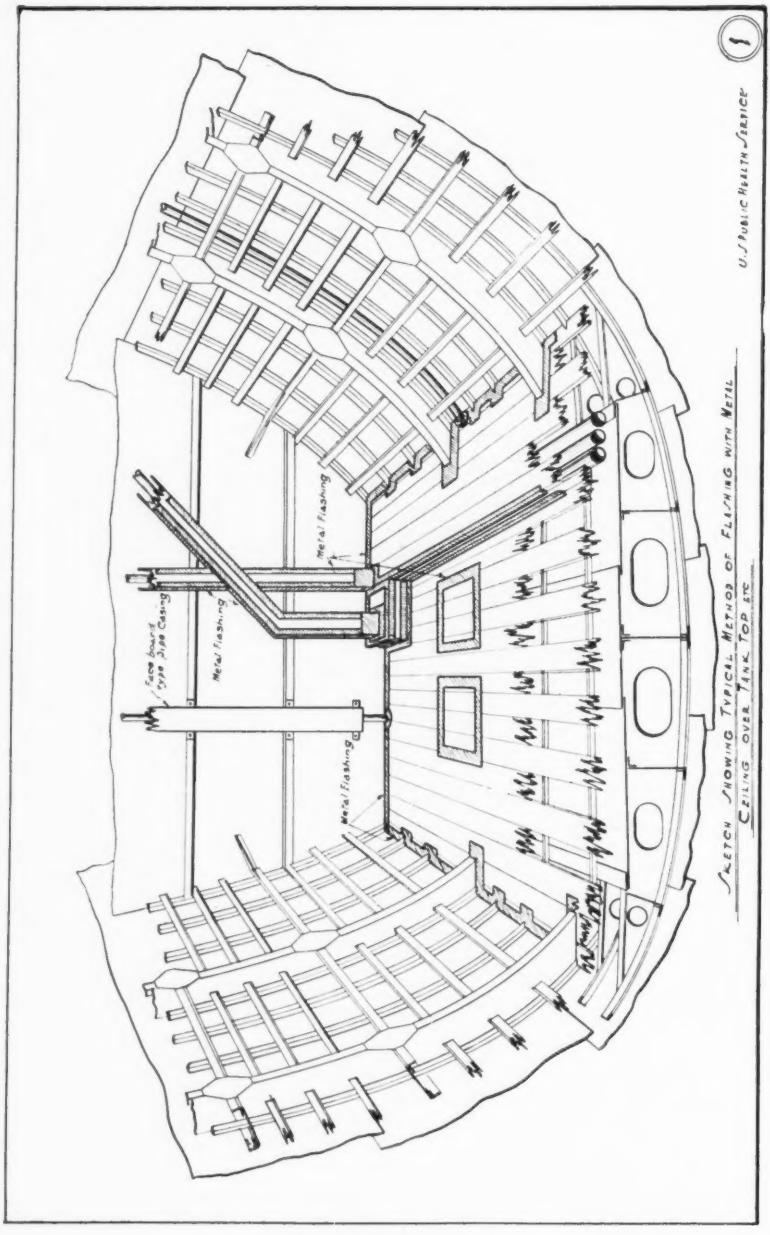
No. 38. *Toilets and baths.*—No detail drawing was made for rat-proofing work in toilets and baths, for the reason that the drawing referred to above, 37B–B, and drawing No. 26 show in detail the general requirement of rat-proofing work which has to be done in toilets and baths.

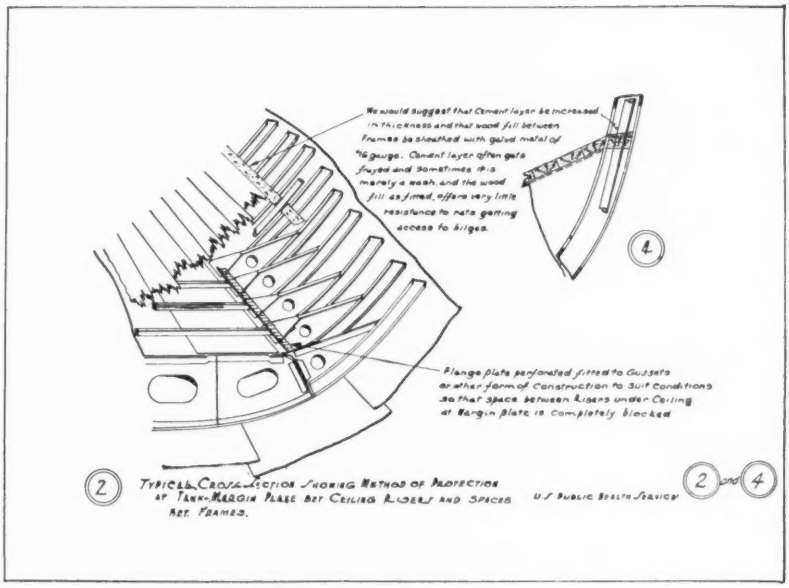
No. 42. *Air duct supply openings.*—The screening of these openings is covered in detail drawing No. 44–45–46. No special drawing was made of No. 42 for the reason that the work is identical with that described on the drawings mentioned above, which consists of installing suitable ½-inch wire mesh properly framed and secured in place.

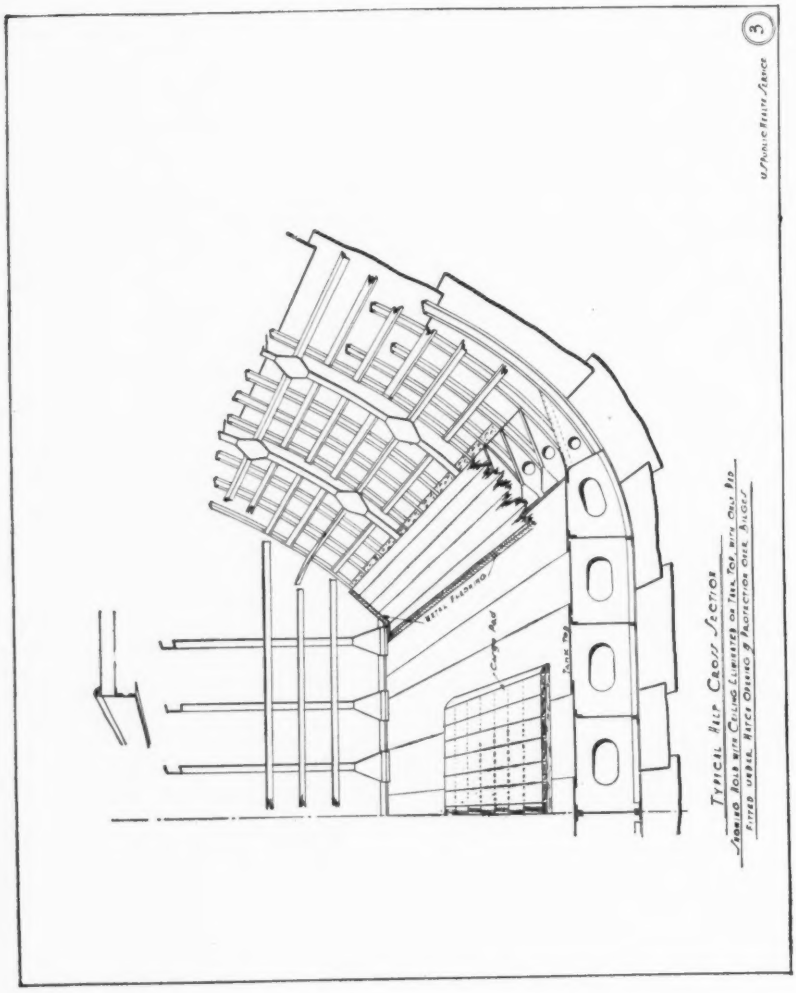
No. 43. *Air duct lines.*—The rat-proofing methods recommended for such duct lines are covered in detail drawing No. 43–37D–D.

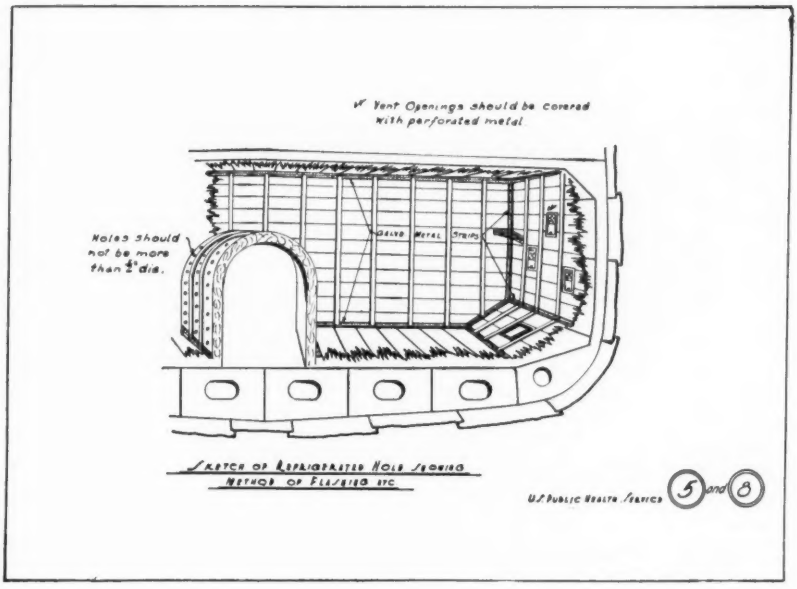
No. 44. *T-shaped ventilators to deck houses.*—The detail of the rat-proofing work required to protect this type of ventilator is given on the drawing which is marked "44–45 and 46" and covers such ventilators, cowls, and blowers.

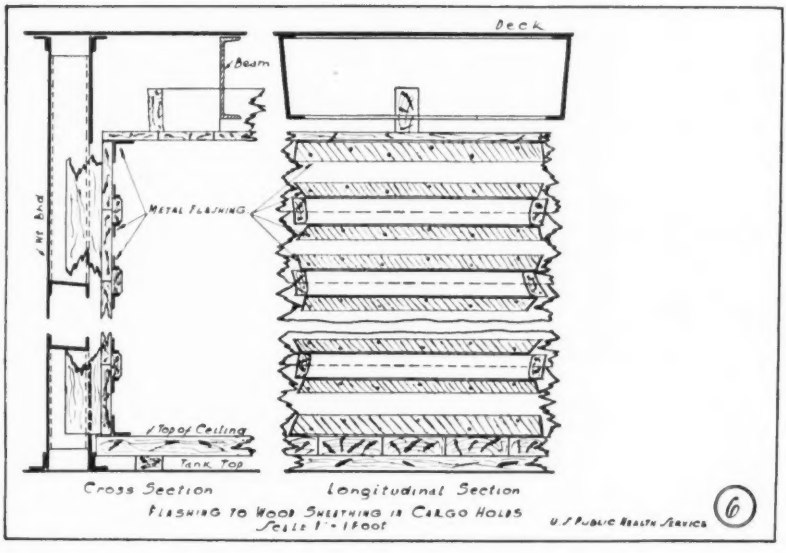
No. 46. *Cowls.*—This item is covered on the drawing just mentioned above.

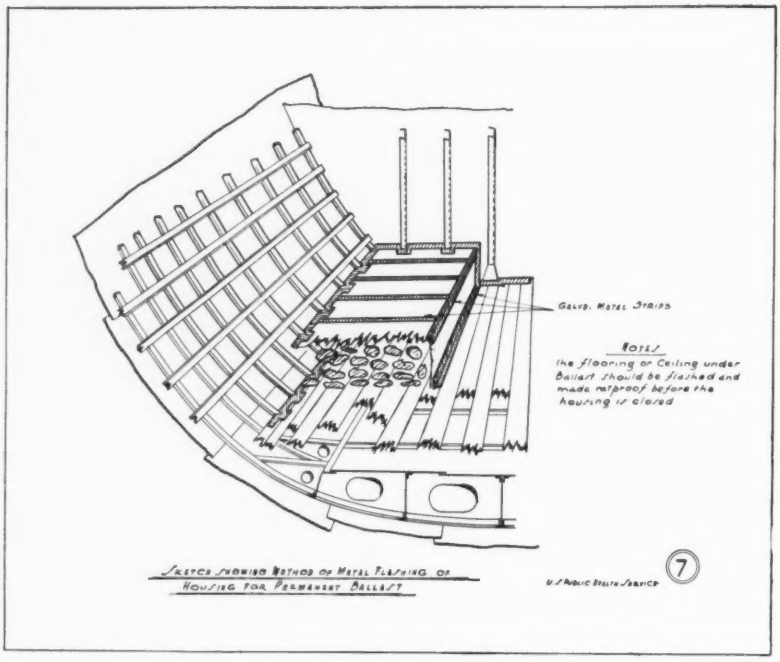

1
U.S. PUBLIC HEALTH SERVICE
SKETCH SHOWING TYPICAL METHOD OF FLASHING WITH METAL
CEILING OVER TANK TOP ETC.
Metal Flashing
Metal Flashing
Metal Flashing
Face board
Pipe Casing

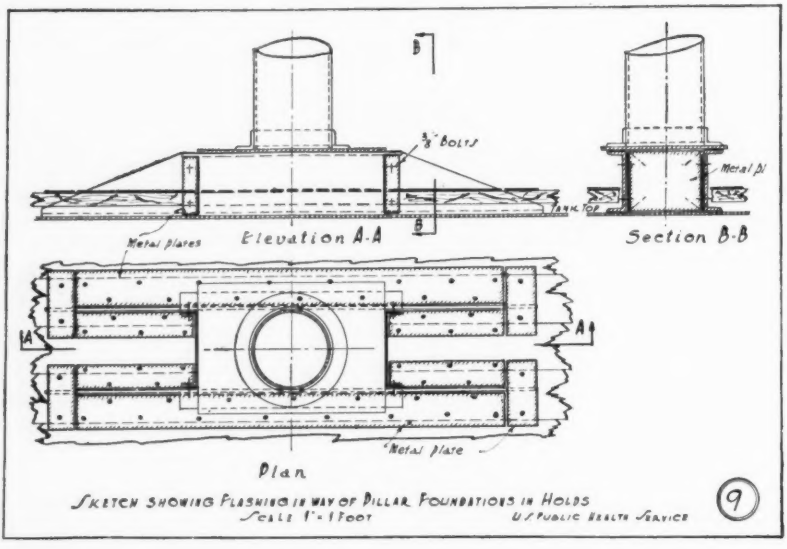

We would suggest that Cement layer be increased in thickness and that wood fill between Frames be sheathed with galvd metal of 16 gauge. Cement layer often gets frayed and sometimes it is merely a wash, and the wood fill as fitted, offers very little resistance to rats getting access to bilges.
4
Flange plate perforated fitted to Gussets or other form of Construction to suit Conditions so that space between Risers under Ceiling at Margin plate is completely blocked
2
TYPICAL CROSS-SECTION SHOWING METHOD OF PROTECTION AT TANK-MARGIN PLATE BET CEILING RISERS AND SPACES BET FRAMES.
U.S PUBLIC HEALTH SERVICE
2 and 4

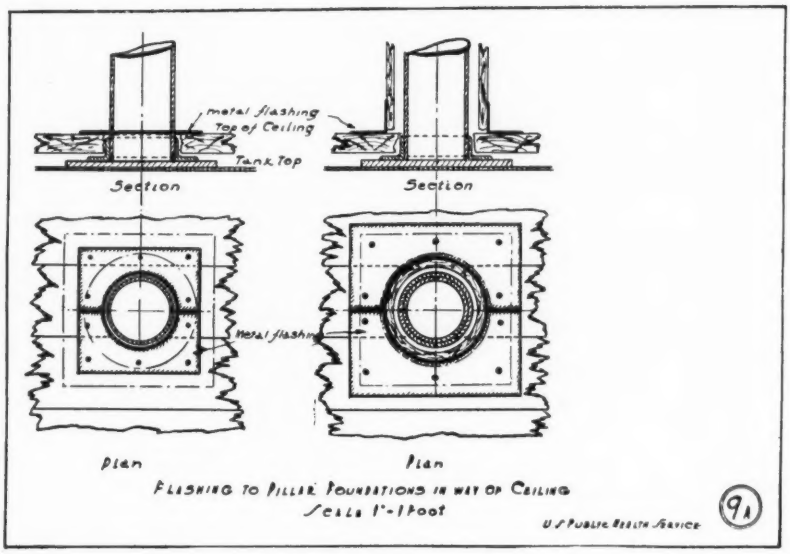

3
U.S. PUBLIC HEALTH SERVICE
METAL FLASHING
COAMING PLATE
DECK PLATE
TYPICAL HALF CROSS SECTION
SHOWING HOLD WITH CEILING ELIMINATED ON THE TOP WITH ONLY ONE
FLOOR UNDER HATCH OPENING & PROTECTION OVER ANGLES

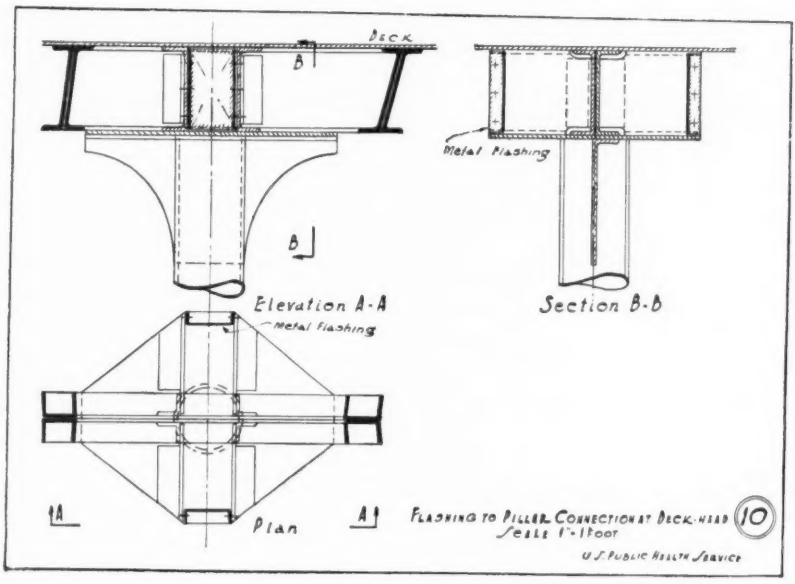

Vent Openings should be covered with perforated metal
Holes should not be more than ½" dia.
Galvd Metal Strips
Sketch of Refrigerated Hold showing Method of Flashing etc
U.S. Public Health Service
5 and 8

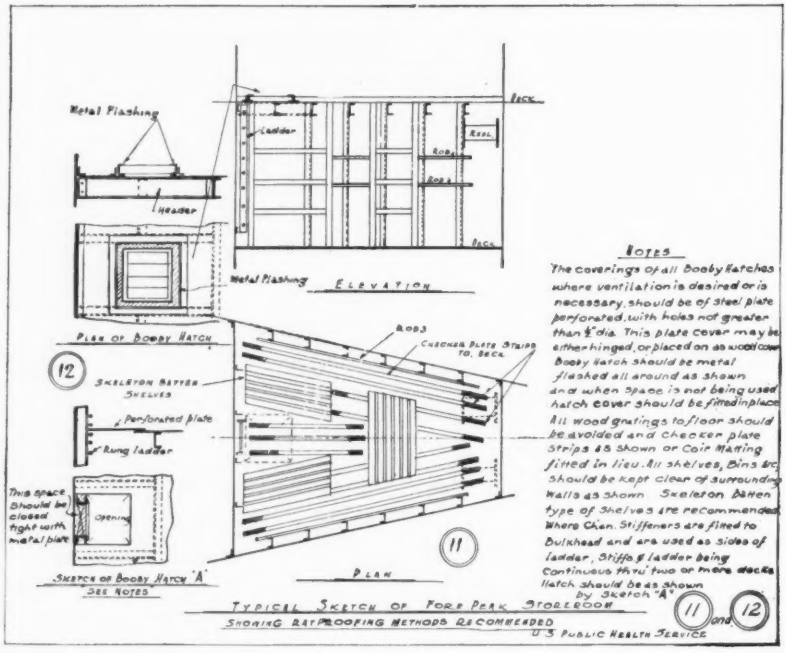

Deck
Beam
Ht. Bhd
Metal Flashing
Top of Ceiling
Tank Top
Cross Section
Longitudinal Section
Flashing to Wood Sheathing in Cargo Holds
Scale 1" - 1 Foot
U.S. Public Health Service
6


Galvd. Metal Strips
Note
the flooring or Ceiling under Ballast should be flashed and made ratproof before the housing is closed
Sketch showing Method of Metal Flashing of Housing for Permanent Ballast
U.S. Public Health Service
7


B
⅝" Bolts
Metal plates
Elevation A-A
Tank Top
Metal pl
Section B-B
A
A
Metal plate
Plan
Sketch showing Flashing in way of Pillar Foundations in Holds
Scale 1"=1 Foot
U.S. Public Health Service
9


metal flashing
Top of Ceiling
Tank Top
Section
Section
Metal flashing
Plan
Plan
FLASHING TO PILLER FOUNDATIONS IN WAY OF CEILING
SCALE 1"-1 Foot
U.S. PUBLIC HEALTH SERVICE
9A


DECK
B
B
Elevation A-A
Metal Flashing
Metal Flashing
Section B-B
A
Plan
A
FLASHING TO PILLER CONNECTION AT DECK-HEAD
SCALE 1"-1 Foot
U.S. PUBLIC HEALTH SERVICE
10


Metal Flashing
Ladder
Deck
Rail
Rods
Rods
Deck
Header
Metal Flashing
ELEVATION
PLAN OF BOOBY HATCH
Rods
Checker Plate Steps to Deck
12
Skeleton Batten Shelves
Perforated Plate
Rung ladder
This space Should be closed tight with metal plate
Opening
SKETCH OF BOOBY HATCH 'A'
See Notes
PLAN
11
NOTES
The coverings of all Booby Hatches where ventilation is desired or is necessary, should be of steel plate perforated, with holes not greater than ½" dia. This plate cover may be either hinged, or placed on as wood cover Booby Hatch should be metal flashed all around as shown and when space is not being used hatch cover should be fitted in place. All wood gratings to floor should be avoided and Checker plate strips as shown or Coir Matting fitted in lieu. All shelves, Bins etc should be kept clear of surrounding walls as shown Skeleton batten type of shelves are recommended. Where Chan. Stiffeners are fitted to bulkhead and are used as sides of ladder, Stiffs of ladder being continuous thru' two or more decks Hatch should be as shown by Sketch "A"
TYPICAL SKETCH OF FORE PEAK STORE ROOM
SHOWING RAT PROOFING METHODS RECOMMENDED
11 and 12
U.S. PUBLIC HEALTH SERVICE

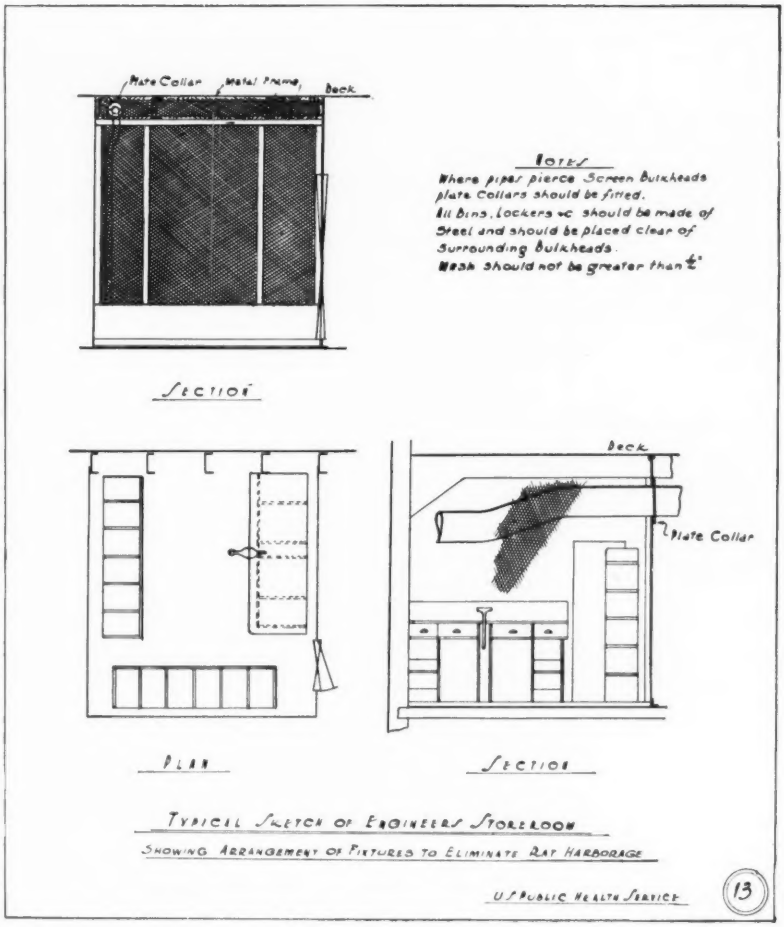
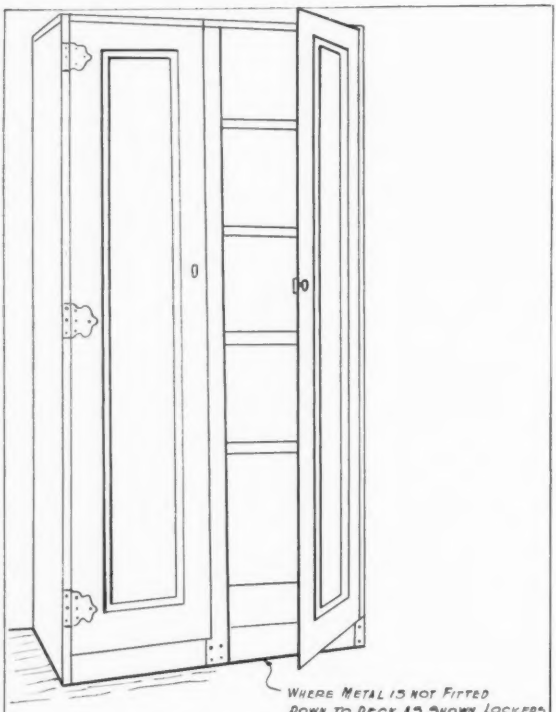


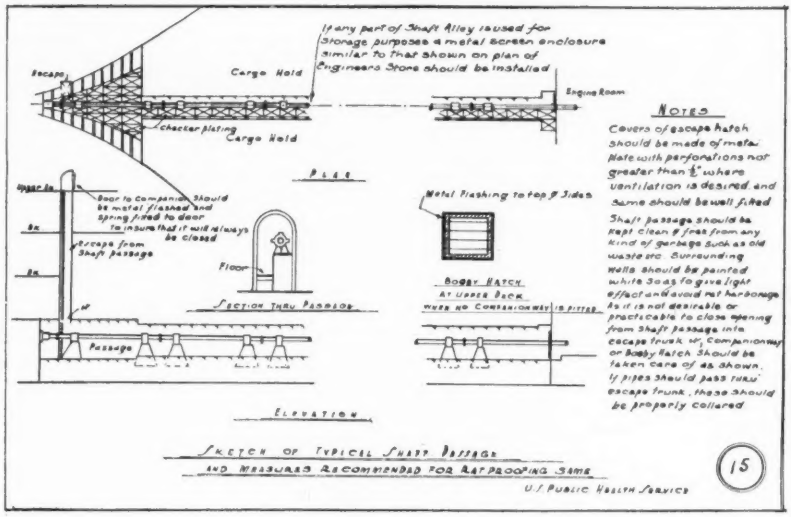
Plate Collar
Metal Frame
Deck
Notes
Where pipes pierce Screen Bulkheads plate Collars should be fitted.
All Bins, Lockers etc should be made of Steel and should be placed clear of Surrounding Bulkheads.
Mesh should not be greater than ¼"
SECTION
PLAN
Deck
Plate Collar
SECTION
TYPICAL SKETCH OF ENGINEERS STORE ROOM
SHOWING ARRANGEMENT OF FIXTURES TO ELIMINATE RAT HARBORAGE
U.S. PUBLIC HEALTH SERVICE
13

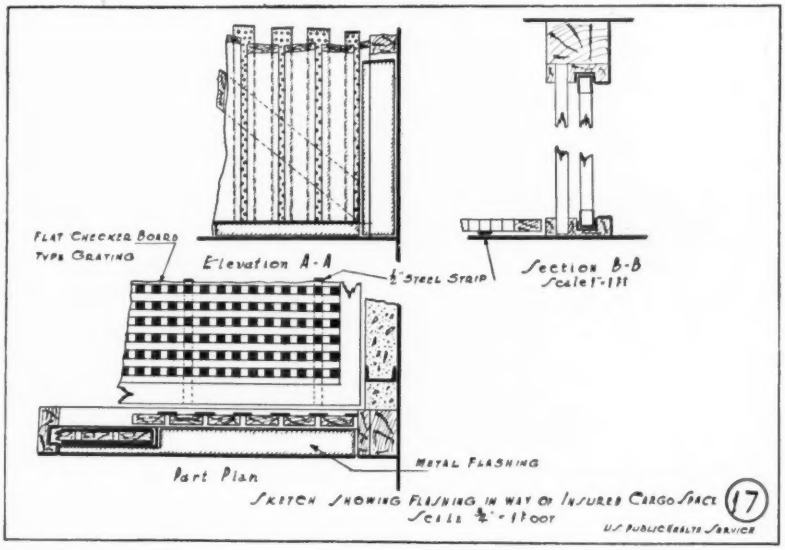


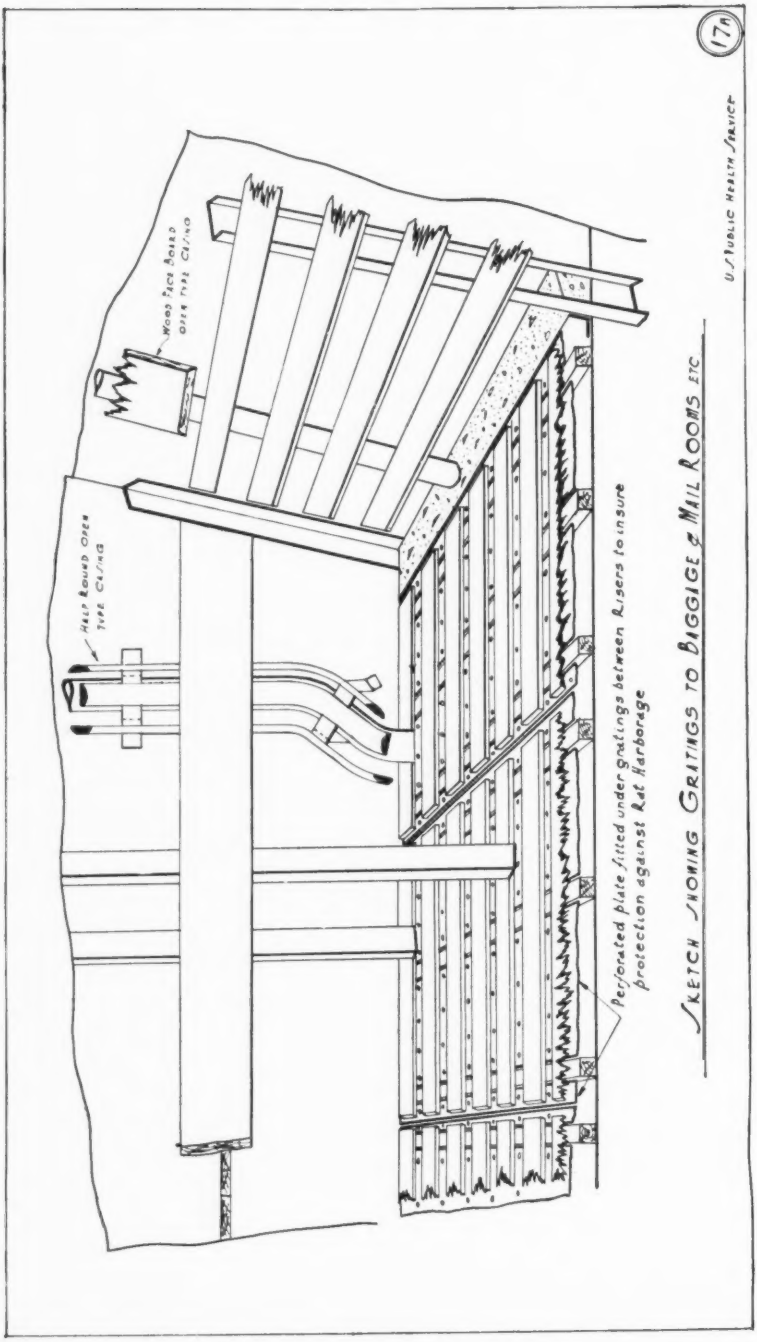
SKETCH OF TYPICAL ENGINEERS LOCKER FOR WASTE & OTHER STORES.

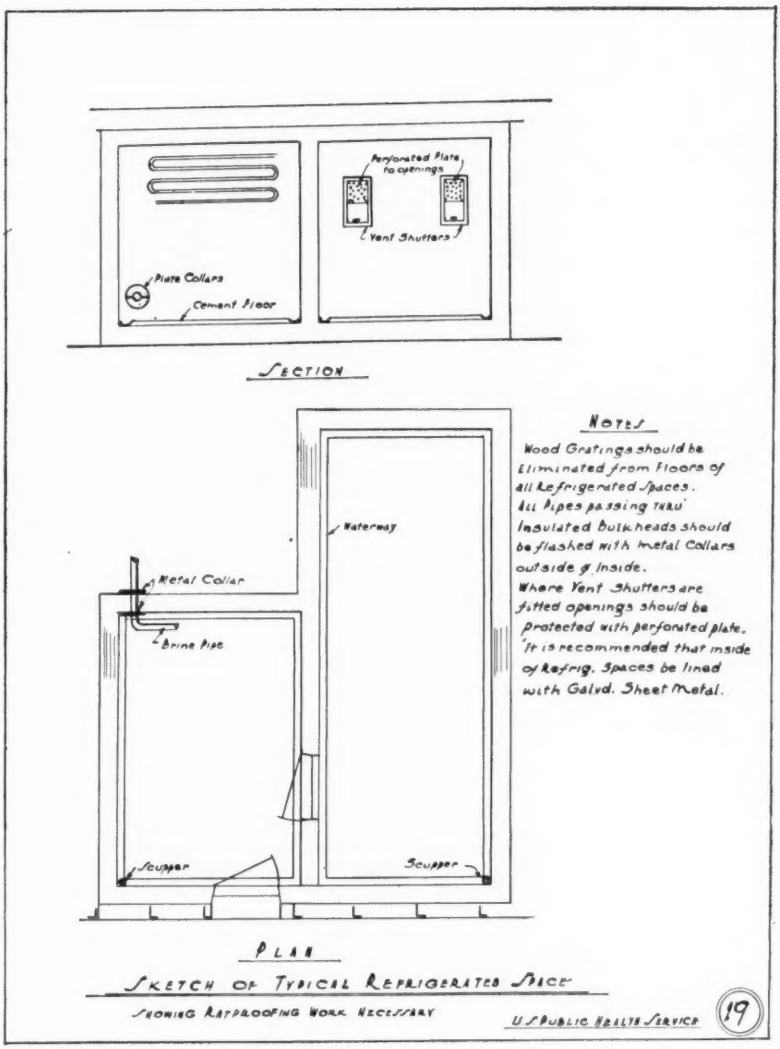
13A

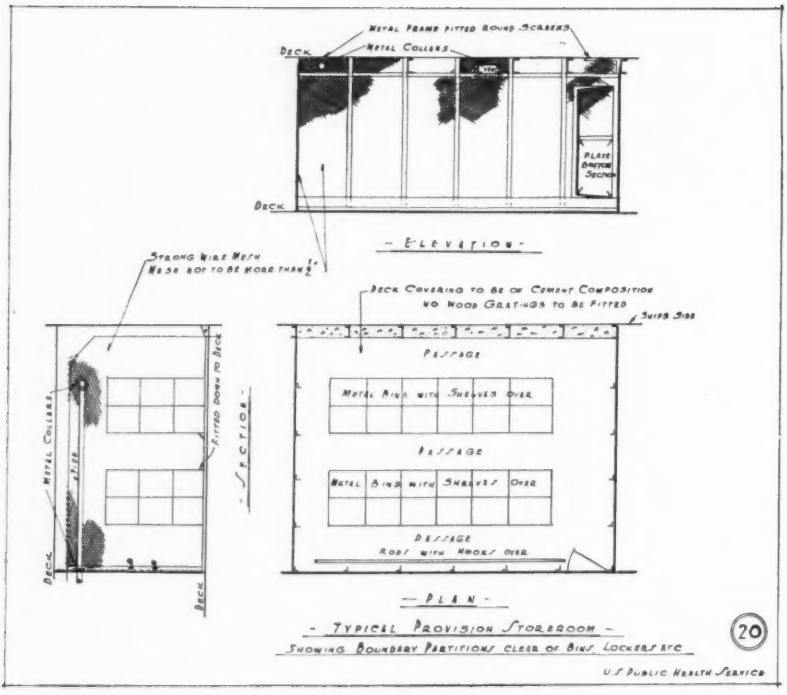
U.S. PUBLIC HEALTH SERVICE

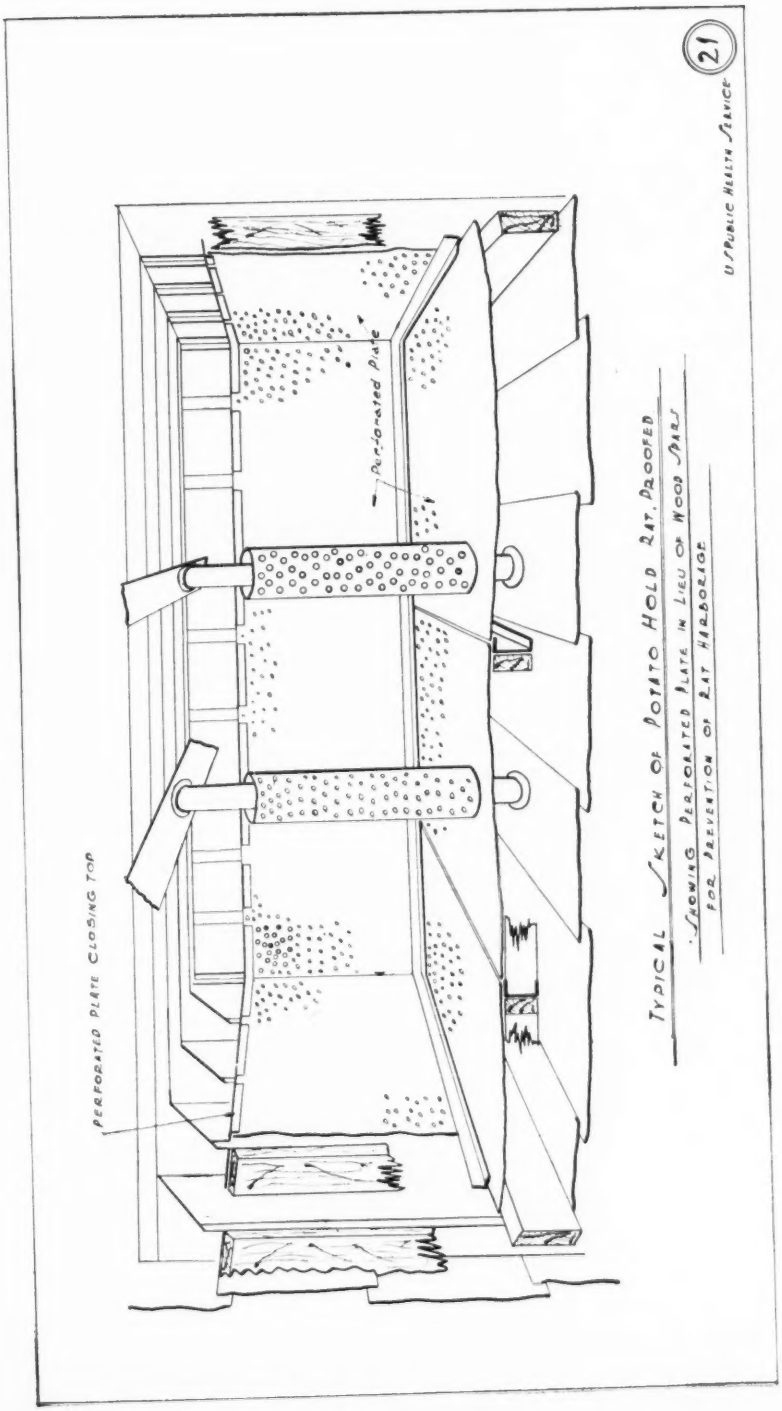

If any part of Shaft Alley is used for Storage purposes a metal screen enclosure similar to that shown on plan of Engineers Store should be installed
Escape
Cargo Hold
Engine Room
Checker Plating
Cargo Hold
PLAN
Upper Dk
Main Dk
Door to Companion should be metal flashed and spring fitted to door to ensure that it will always be closed
Escape from Shaft passage
Floor
Metal Flashing to top & Sides
BOBBY HATCH AT UPPER DECK WHERE NO COMPANION WAY IS FITTED
SECTION THRU PASSAGE
Passage
ELEVATION
NOTES
Covers of escape hatch should be made of metal plate with perforations not greater than ¼" where ventilation is desired and same should be well fitted
Shaft passage should be kept clean & free from any kind of garbage such as old waste etc. Surrounding walls should be painted white so as to give light effect and avoid rat harbourage
As it is not desirable or practicable to close opening from Shaft passage into escape trunk, Companionway or Bobby Hatch should be taken care of as shown.
If pipes should pass thru' escape trunk, these should be properly collared
SKETCH OF TYPICAL SHAFT PASSAGE AND MEASURES RECOMMENDED FOR RAT PROOFING SAME
15
U.S. PUBLIC HEALTH SERVICE

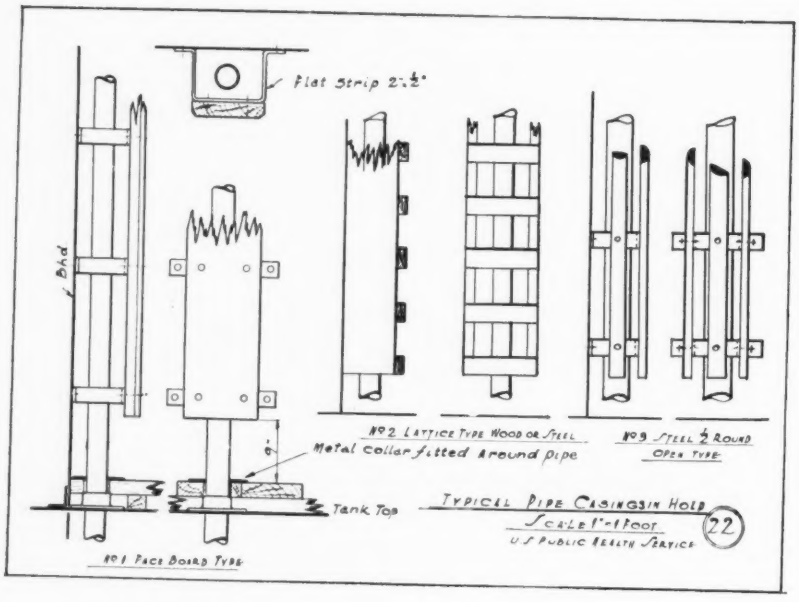

FLAT CHECKER BOARD TYPE GRATING
Elevation A-A
½" STEEL STRIP
Section B-B
Scale 1"-1ft
METAL FLASHING
Part Plan
SKETCH SHOWING FLASHING IN WAY OF INSURED CARGO SPACE
SCALE ½"-1 FOOT
17
U.S. PUBLIC HEALTH SERVICE

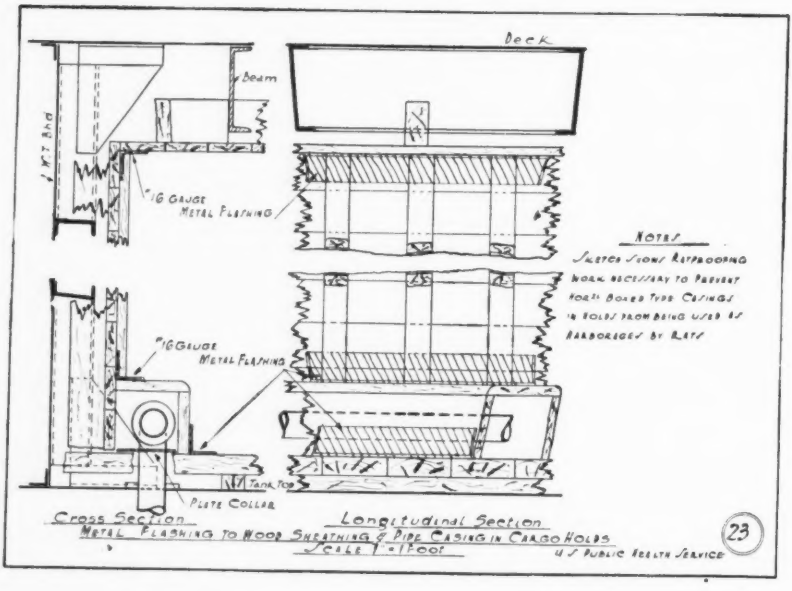

17a
U.S. PUBLIC HEALTH SERVICE
WOOD FACE BOARD OVER TOP CLING
HOLD ROUND OVER TOP CLING
Perforated plate fitted under gratings between risers to insure protection against Rat Harborage
SKETCH SHOWING GRATINGS TO BIGGIGE & MAIL ROOMS ETC

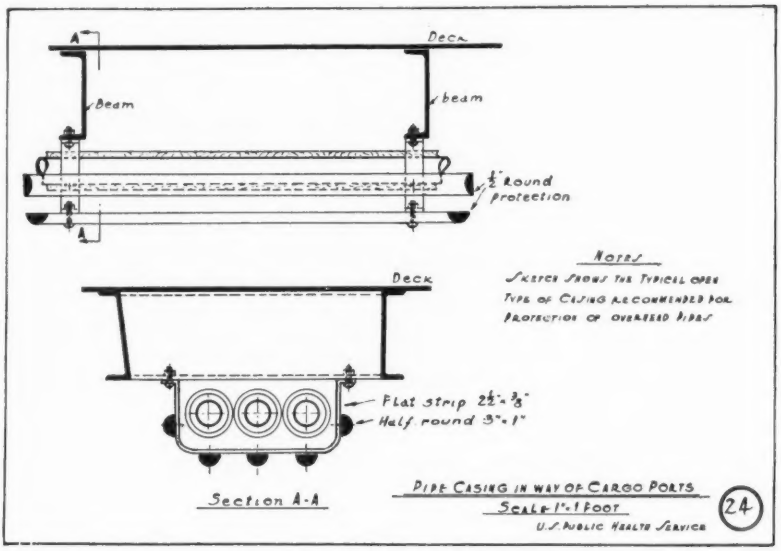

Perforated Plate to openings
Vent Shutters
Plate Collars
Cement Floor
SECTION
Waterway
Metal Collar
Brine Pipe
Scupper
Scupper
PLAN
NOTES
Wood Gratings should be Eliminated from Floors of all Refrigerated Spaces.
All Pipes passing THRU' Insulated Bulk heads should be flashed with Metal Collars outside & inside.
Where Vent Shutters are fitted openings should be protected with perforated plate.
It is recommended that inside of Refrig. Spaces be lined with Galvd. Sheet Metal.
SKETCH OF TYPICAL REFRIGERATED SPACE
SHOWING RATPROOFING WORK NECESSARY
U.S PUBLIC HEALTH SERVICE
19

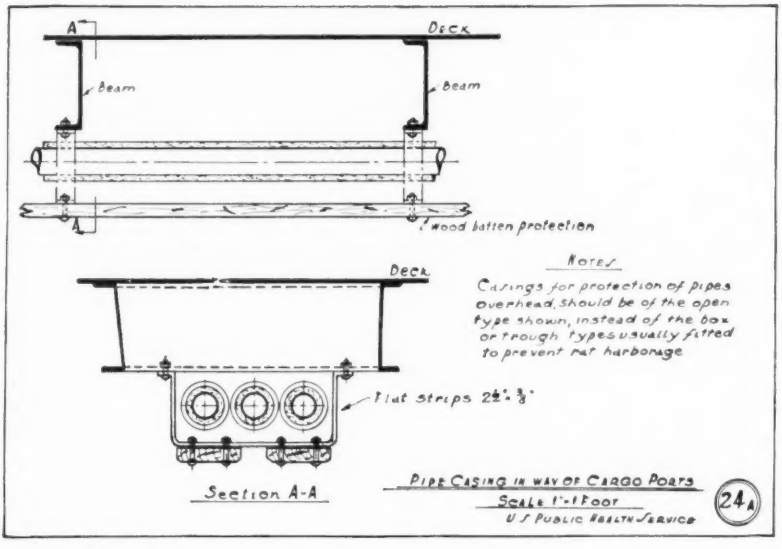

METAL FRAME FITTED ROUND SCARFS
METAL COLLARS
DECK
DECK
PLATE BATTOM SECTION
- ELEVATION -
STRONG WIRE MESH MESH NOT TO BE MORE THAN ½"
DECK COVERING TO BE OF CEMENT COMPOSITION NO WOOD GRATINGS TO BE FITTED
SLIDE SIDE
PASSAGE
METAL BINS WITH SHELVES OVER
PASSAGE
METAL BINS WITH SHELVES OVER
PASSAGE
RODS WITH HOOKS OVER
METAL COLLARS
FITTED DOWN TO DECK
- SECTION -
DECK
DECK
- PLAN -
- TYPICAL PROVISION STOREROOM -
SHOWING BOUNDERY PARTITIONS CLEAR OF BINS, LOCKERS ETC
20
U.S. PUBLIC HEALTH SERVICE

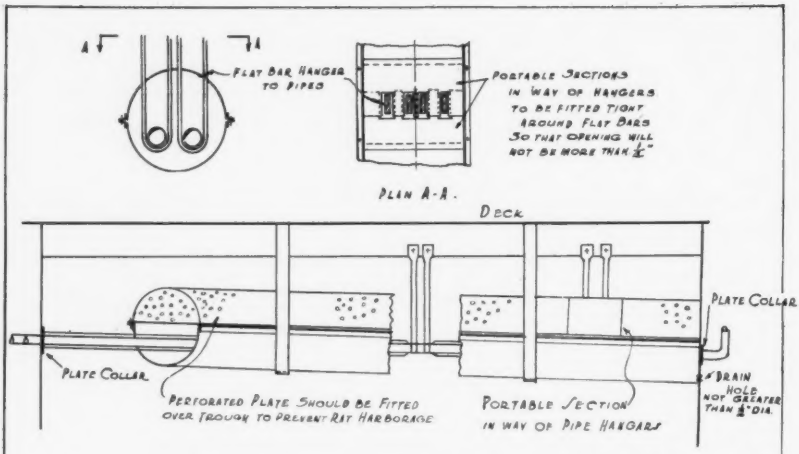

21
U.S. PUBLIC HEALTH SERVICE
PERFORATED PLATE CLOSING TOP
Perforated Plate
TYPICAL SKETCH OF POTATO HOLD RAT PROOFED
SHOWING PERFORATED PLATE IN LIEU OF WOOD BARS
FOR PREVENTION OF RAT HARBORAGE


Flat Strip 2"x½"
Bhd
No 2 Lattice Type Wood or Steel
No 9 Steel ½ Round Open Type
Metal collar fitted around pipe
Tank Top
No 1 Face Board Type
Typical Pipe Casings in Hold
Scale 1"=1 Foot
U S Public Health Service
22

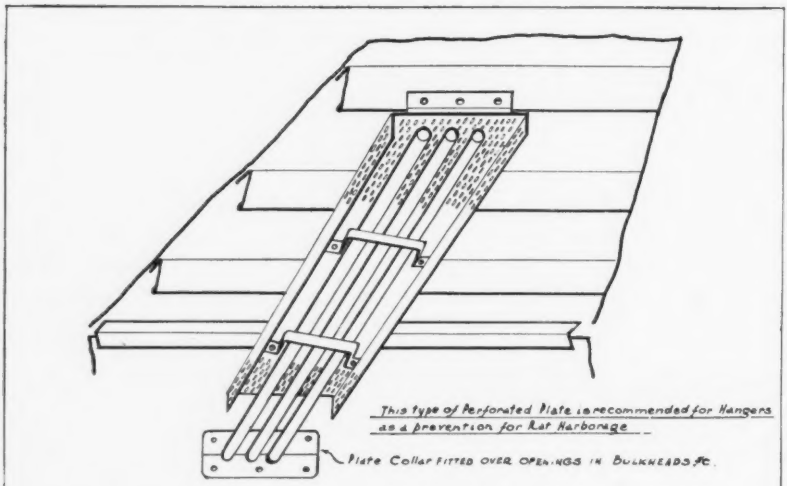

Deck
Beam
Bhd
16 Gauge Metal Flashing
Notes
Sketch shows Ratproofing work necessary to prevent Non-Boiled Type Casings in Holds from being used as Harborages by Rats
Tank Top
Plate Collar
Cross Section
Longitudinal Section
Metal Flashing to Wood Sheathing & Pipe Casing in Cargo Holds
Scale 1"=1 Foot
U S Public Health Service
23


A
Deck
Beam
beam
A
½" Round protection
Deck
Flat strip 2½"×⅜"
Half round 3"×1"
Section A-A
Notes
Sketch shows the typical open type of casing recommended for protection of overhead pipes
Pipe Casing in way of Cargo Ports
Scale 1"=1 Foot
U.S. Public Health Service
24


A
Deck
Beam
Beam
A
1" wood batten protection
Deck
Flat strips 2½"×⅜"
Section A-A
Notes
Casings for protection of pipes overhead, should be of the open type shown, instead of the box or trough types usually fitted to prevent rat harborage
Pipe Casing in way of Cargo Ports
Scale 1"=1 Foot
U.S. Public Health Service
24A

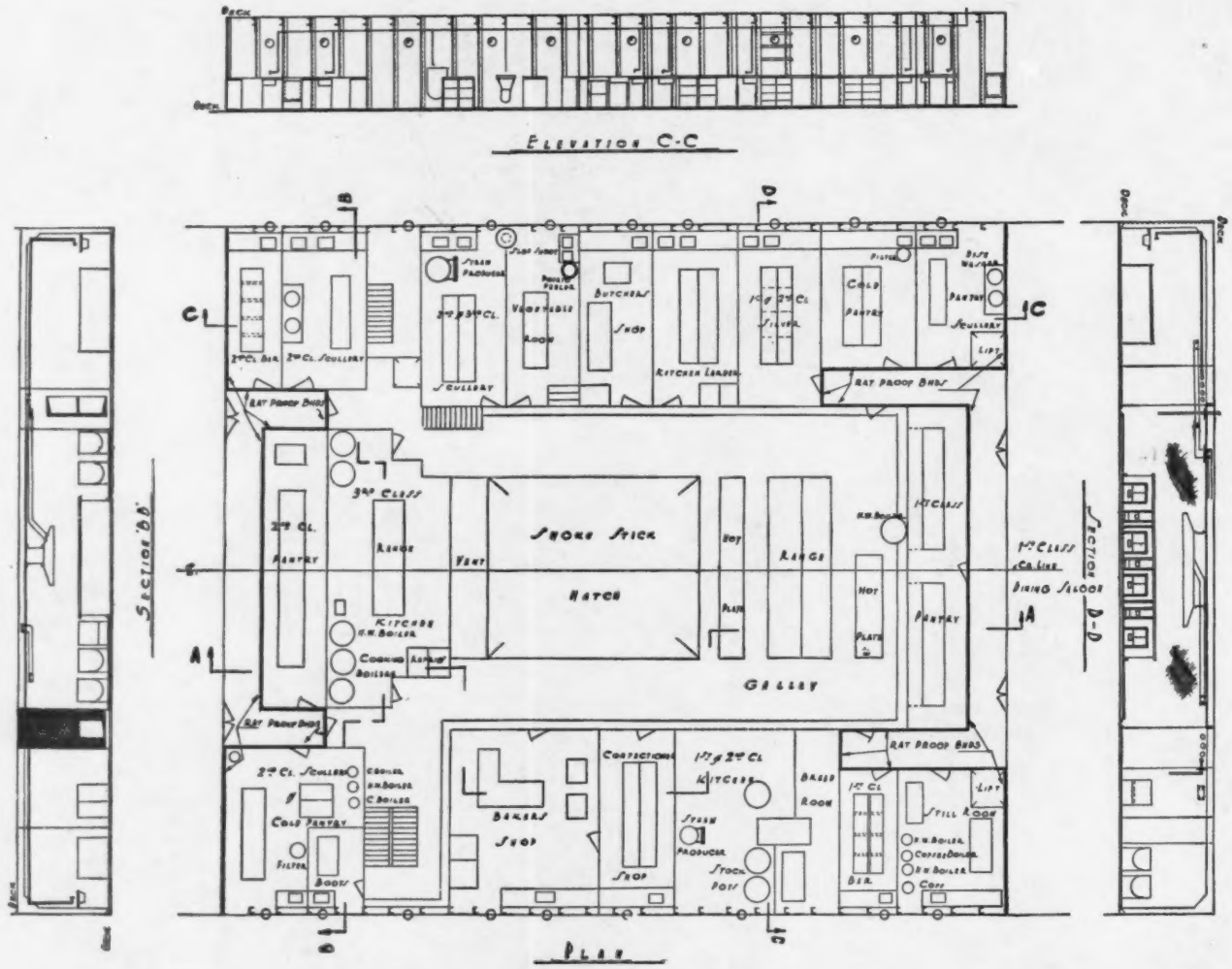

A
A
FLAT BAR HANGER TO PIPES
PORTABLE SECTIONS IN WAY OF HANGERS TO BE FITTED TIGHT AROUND FLAT BARS SO THAT OPENING WILL NOT BE MORE THAN ¼"
PLAN A-A.
DECK
PLATE COLLAR
PLATE COLLAR
PERFORATED PLATE SHOULD BE FITTED OVER TROUGH TO PREVENT RAT HARBORAGE
PORTABLE SECTION IN WAY OF PIPE HANGARS
½" DRAIN HOLE NOT GREATER THAN ¼" DIA.

SKETCH SHOWING TROUGH FOR STEAM PIPES OR BRINE PIPES PASSING THRU BAGGAGE ROOM OR STORE ROOMS WHERE DRIPPING IS INVOLVED — U/S PUBLIC HEALTH SERVICE — 24B


This type of Perforated Plate is recommended for Hangers as a prevention for Rat Harborage
Plate Collar Fitted over openings in Bulkheads &c.

TYPICAL SKETCH OF HANGER FOR ELECTRIC CABLES &C

U.S. PUBLIC HEALTH SERVICE — 25



SUGGESTED LAYOUT OF GALLEY SECTION

SHOWING TYPICAL ARRANGEMENT OF FIXTURES, RANGES ETC.
TO REDUCE RAT HARBORAGE TO A MINIMUM

NOTES

ALL BOUNDARY PARTITIONS SHOULD BE MADE PROPERLY RAT-PROOF AS SHOWN BY THICK LINES

ALL WIRE MESH PARTITIONS SHOULD BE MADE OF STRONG WIRE WITH MESH NOT MORE THAN ½".

WHERE PIPES OR DUCTS PASS THRU PARTITIONS PLATE COLLARS SHOULD BE FITTED.

SHEATHING UNDER DECK IN WAY OF RANGES SHOULD BE OF SHEET STEEL, CARE BEING TAKEN TO HAVE ENDS PROPERLY CLOSED. WHERE PIPES OR DUCTS PIERCE SHEATHING PLATE COLLARS SHOULD BE FITTED

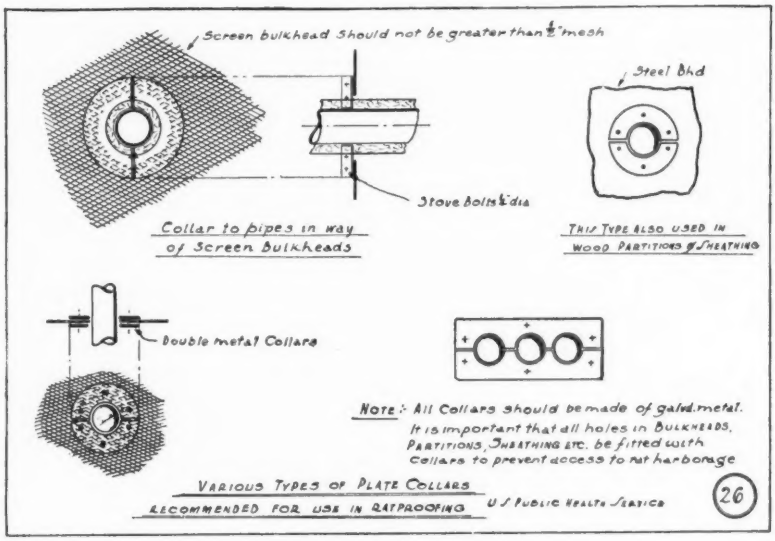
ALL FIXTURES SHOULD BE FITTED CLEAR OF PARTITIONS AS SHOWN.

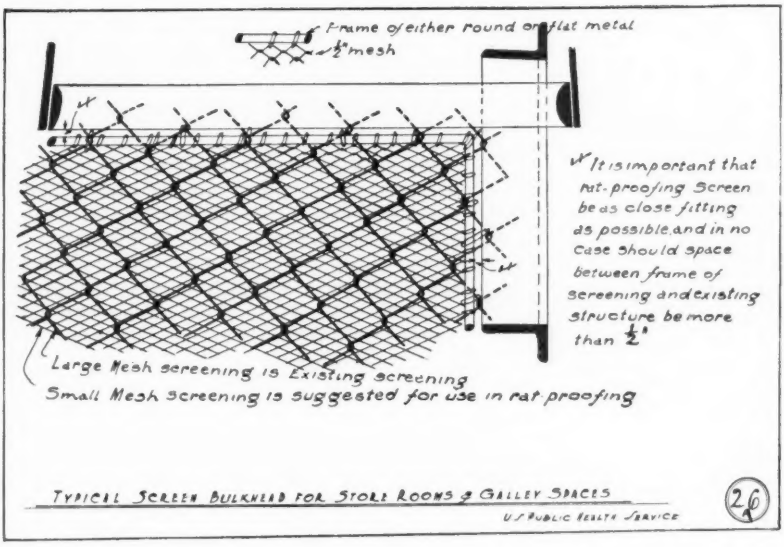
SHEATHING SHOULD BE ELIMINATED FROM SHIPS SIDE AS SHOWN

RANGES ETC. SHOULD BE FITTED DOWN TO DECK OR TILES FITTED TO ELIMINATE OPEN SPACES AT DECK.

(27) (28)

U.S. PUBLIC HEALTH SERVICE


Screen bulkhead should not be greater than ½" mesh
Steel Bhd
Stove Bolts ¼ dia
Collar to pipes in way of Screen Bulkheads
THIS TYPE ALSO USED IN WOOD PARTITIONS & SHEATHING
Double metal Collars
NOTE:- All Collars should be made of galvd. metal. It is important that all holes in BULKHEADS, PARTITIONS, SHEATHING ETC. be fitted with Collars to prevent access to rat harbourage
VARIOUS TYPES OF PLATE COLLARS RECOMMENDED FOR USE IN RATPROOFING
U.S PUBLIC HEALTH SERVICE
26


Frame of either round or flat metal
½" mesh
It is important that rat-proofing Screen be as close fitting as possible, and in no case should space between frame of screening and existing structure be more than ½"
Large Mesh screening is Existing screening
Small Mesh Screening is suggested for use in rat proofing
TYPICAL SCREEN BULKHEAD FOR STORE ROOMS & GALLEY SPACES
U.S PUBLIC HEALTH SERVICE
26A

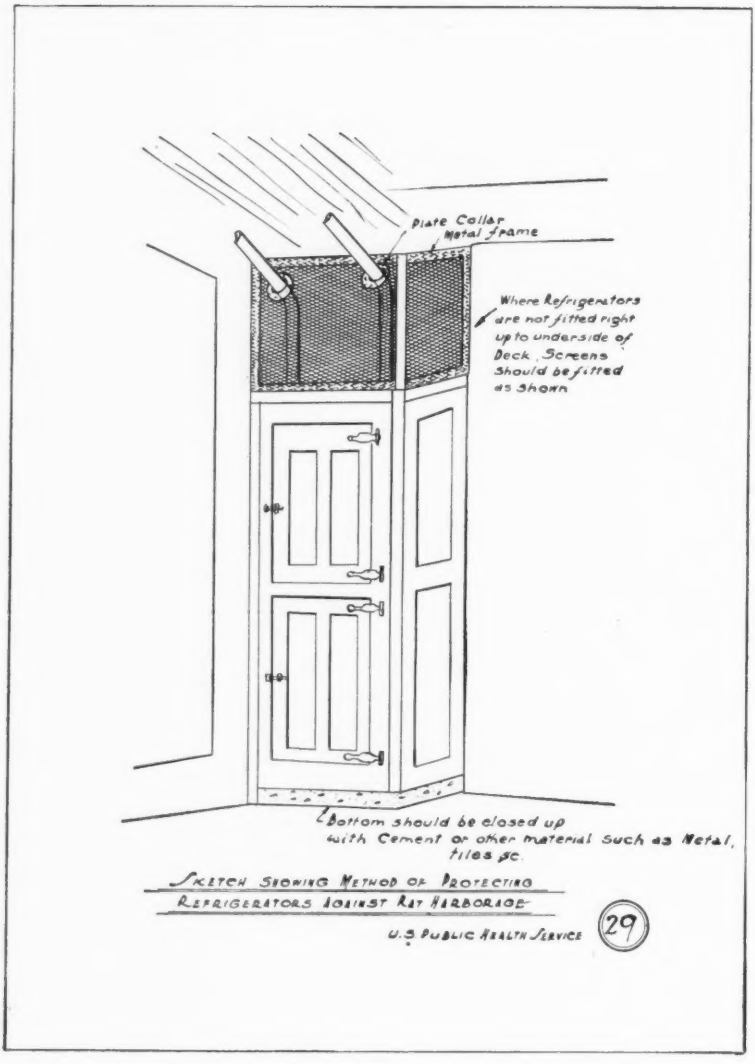
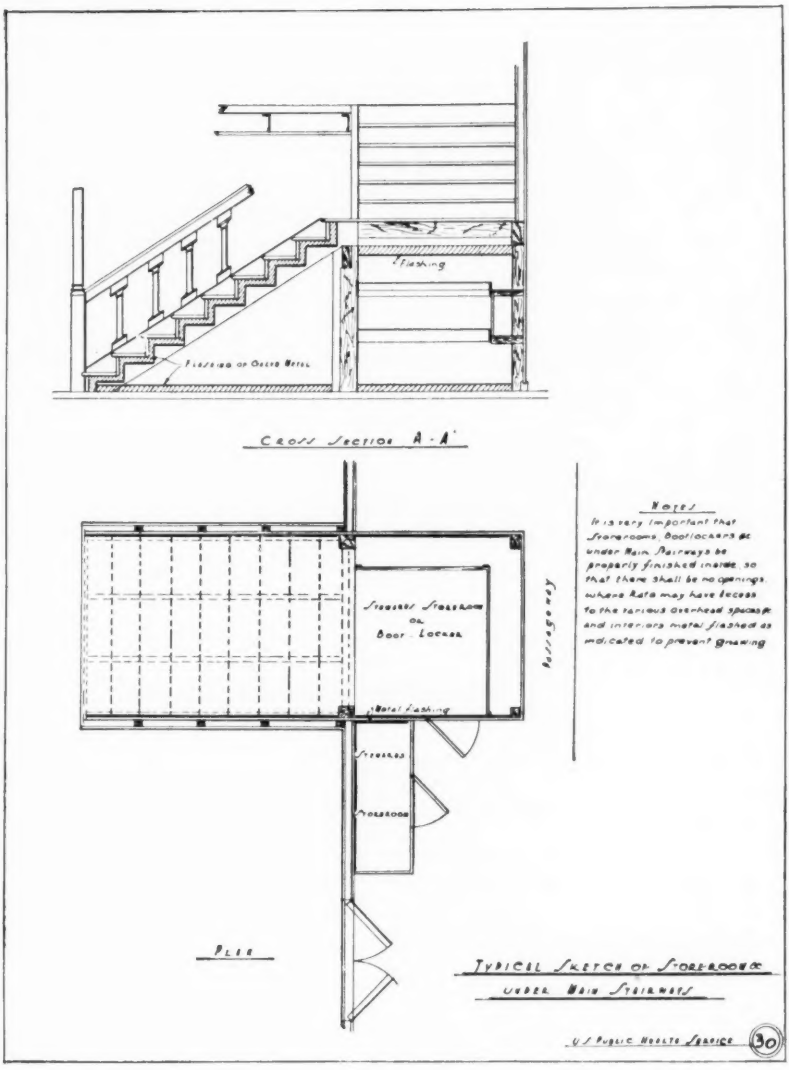
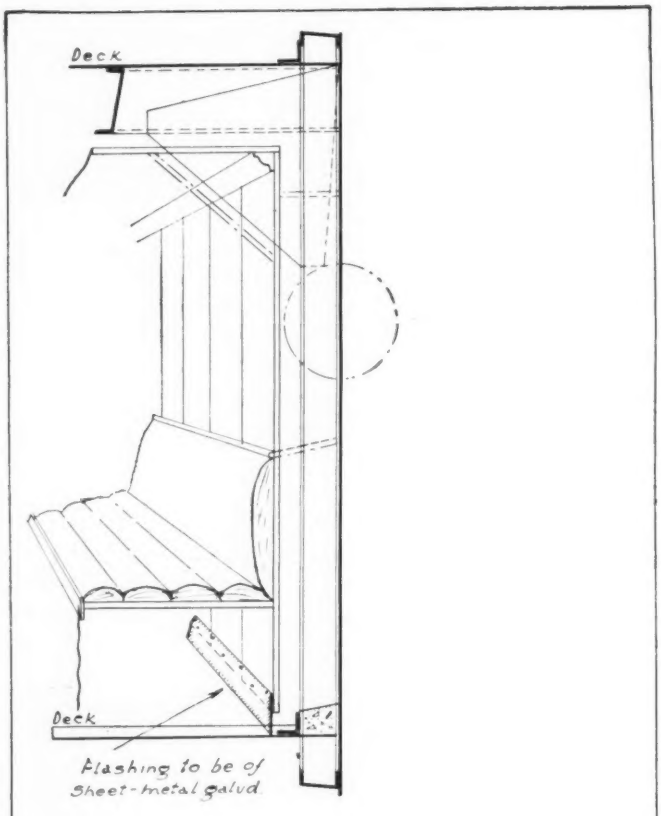
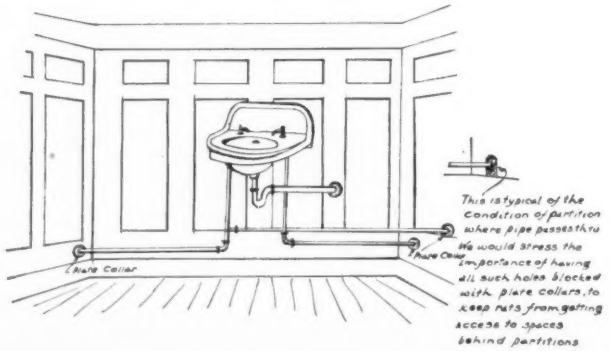


Plate Collar
Metal Frame
Where Refrigerators are not fitted right up to underside of Deck, Screens Should be fitted as Shown
Bottom should be closed up with Cement or other material such as Metal, Tiles &c.
SKETCH SHOWING METHOD OF PROTECTING REFRIGERATORS AGAINST RAT HARBORAGE
U.S. PUBLIC HEALTH SERVICE
29

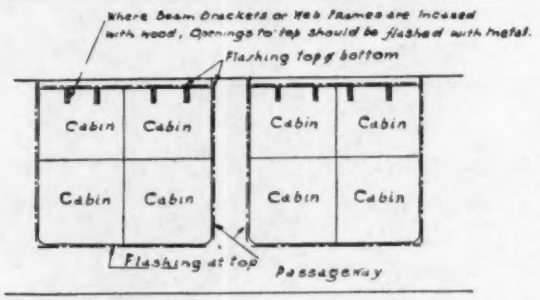

Flashing
Flashing of Galv. Metal
Cross Section A-A'
Steerage Storeroom or Boor Locker
Metal Flashing
Storeroom
Storeroom
Passageway
Notes
It is very important that Storerooms, Boatlockers &c under Main Stairways be properly finished inside so that there shall be no openings where Rats may have access to the various overhead spaces & interiors metal flashed as indicated to prevent gnawing
Plan
Typical Sketch of Storerooms under Main Stairways
U.S. Public Health Service
30



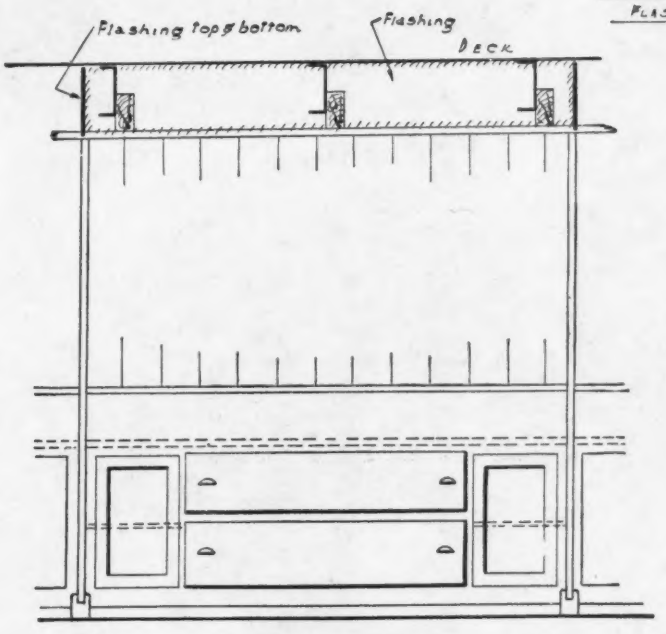
METHOD OF FLASHING WOOD SHEATHING
AT BACK OF SETTEES
SCALE 3/4"-1 FT.
U.S. PUBLIC HEALTH SERVICE
31



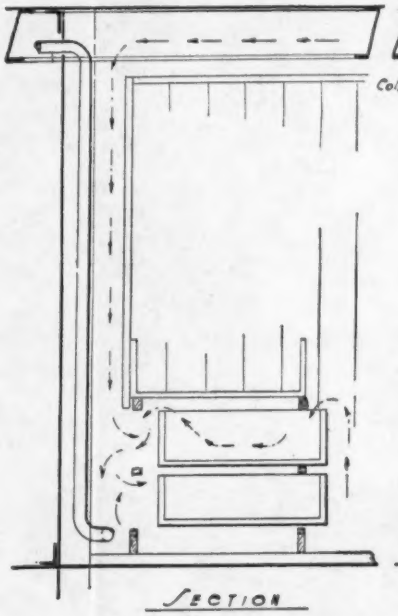
TYPICAL SKETCH OF PIPE LINES TO WASH BASINS
U.S. PUBLIC HEALTH SERVICE
32



SKETCH SHOWING PROPOSED METHOD OF FLASHING STATEROOM SECTIONS

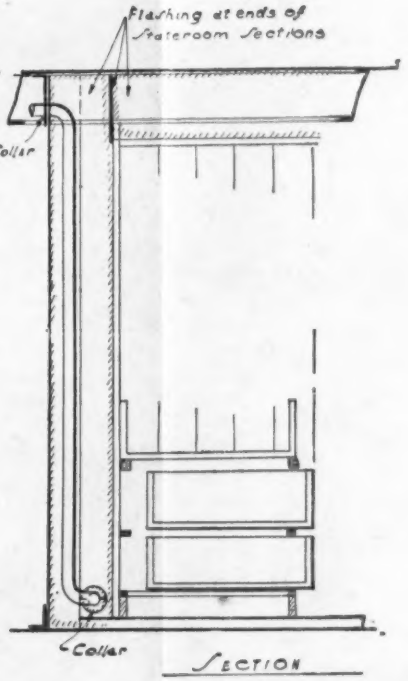


ELEVATION



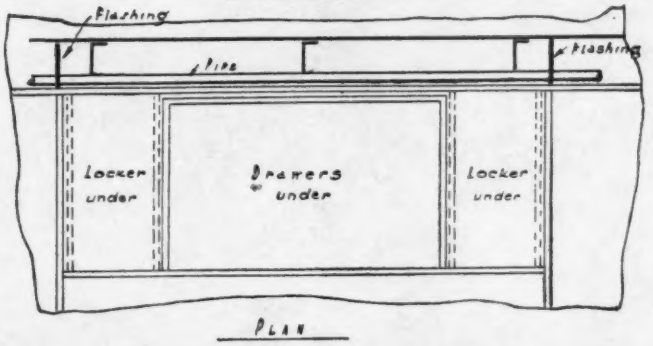
SECTION

TYPICAL OF PRESENT CONDITION



SECTION

PROPOSED METHOD OF CONSTRUCTION TO INSURE AGAINST RAT HARBORAGE



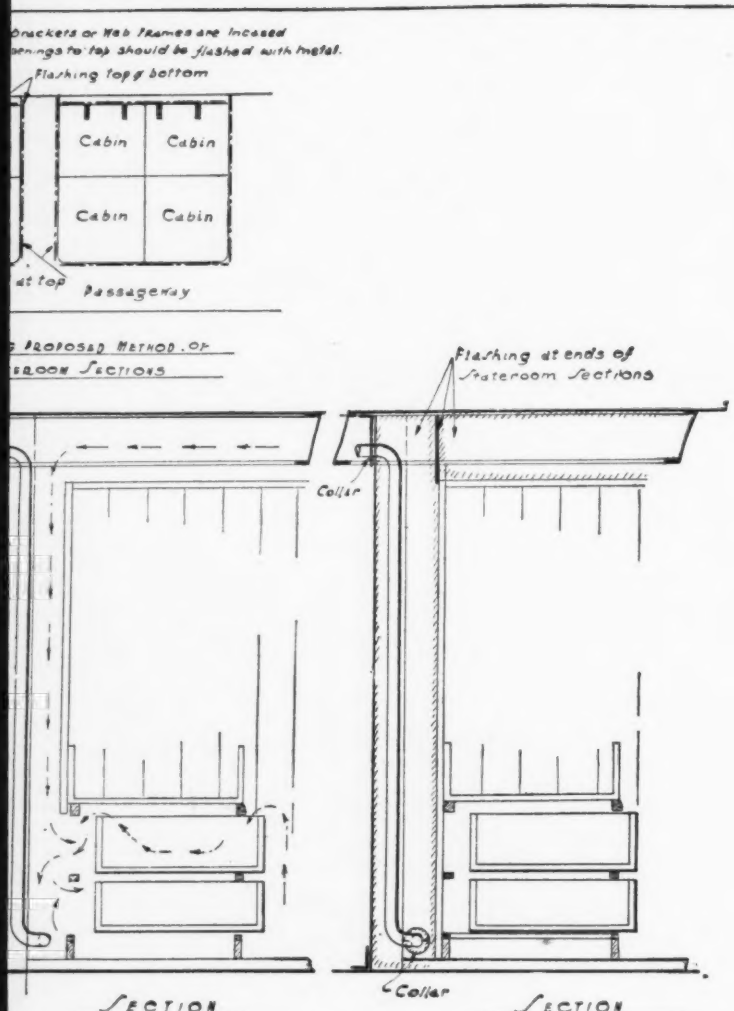
PLAN

SKETCH OF TYPICAL STATEROOMS WITH DRAWERS & LOCKERS UNDER BERTHS

NOTE:- PROPOSED FLASHING SHOULD BE USED GENERALLY THRU'OUT STATEROOM SECTIONS

U.S. PUBLIC HEALTH SERVICE

33

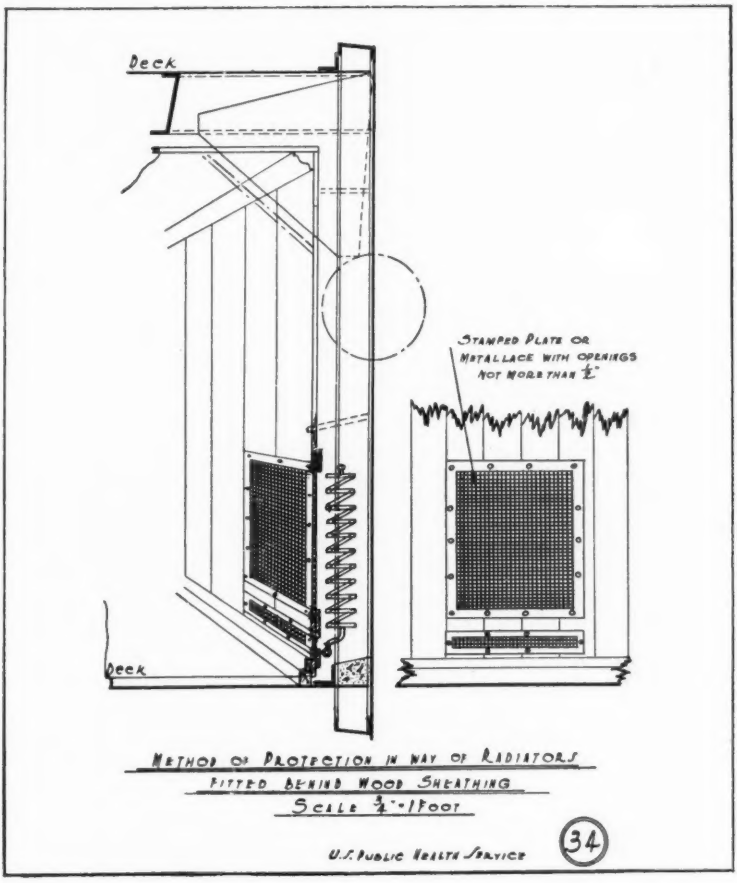


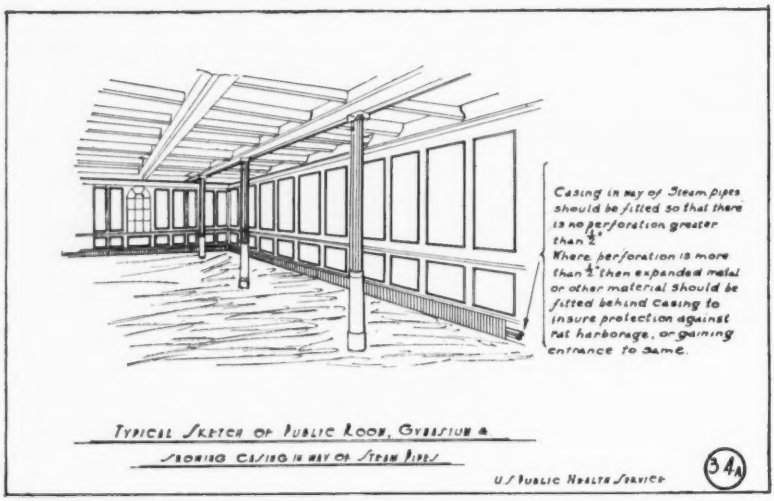
SKETCH OF TYPICAL STATEROOMS WITH
DRAWERS & LOCKERS UNDER BERTHS

PROPOSED FLASHING SHOULD BE USED GENERALLY
THRU'OUT STATEROOM SECTIONS

U.S. PUBLIC HEALTH SERVICE

33

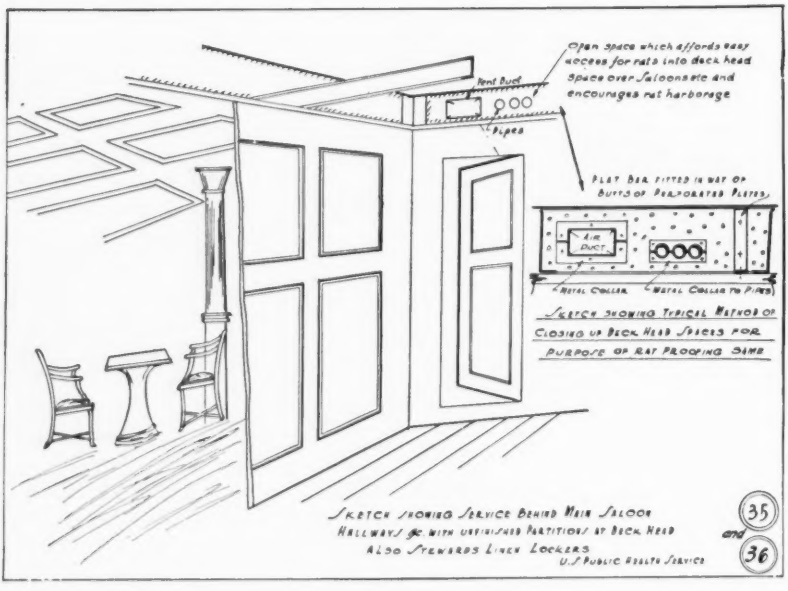

Deck
Deck
STAMPED PLATE OR
METAL LACE WITH OPENINGS
NOT MORE THAN ½"
METHOD OF PROTECTION IN WAY OF RADIATORS
FITTED BEHIND WOOD SHEATHING
SCALE ¾"-1FOOT
U.S. PUBLIC HEALTH SERVICE
34


Casing in way of Steam pipes should be fitted so that there is no perforation greater than 1/2"
Where perforation is more than 1/2" then expanded metal or other material should be fitted behind Casing to insure protection against rat harborage, or gaining entrance to same.

TYPICAL SKETCH OF PUBLIC ROOM, CABIN OR SHOWING CASING IN WAY OF STEAM PIPES

U.S. PUBLIC HEALTH SERVICE

34A

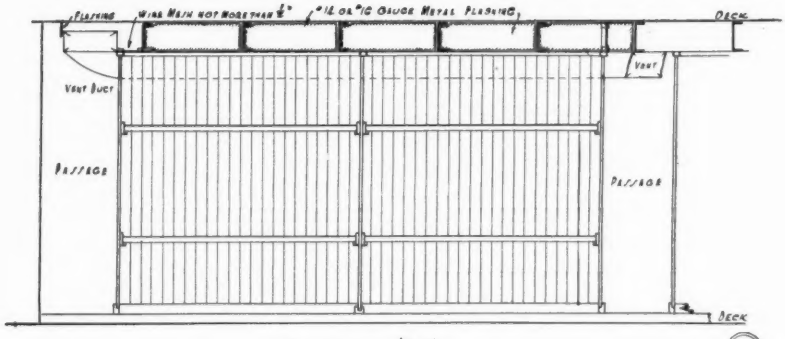

Open space which affords easy access for rats into deck head space over saloon etc and encourages rat harborage
Vent Duct
Pipes
PLAT BER FITTED IN WAY OF BUTTS OF PERFORATED PLATES
AIR DUCT
METAL COLLAR
METAL COLLAR TO PIPES

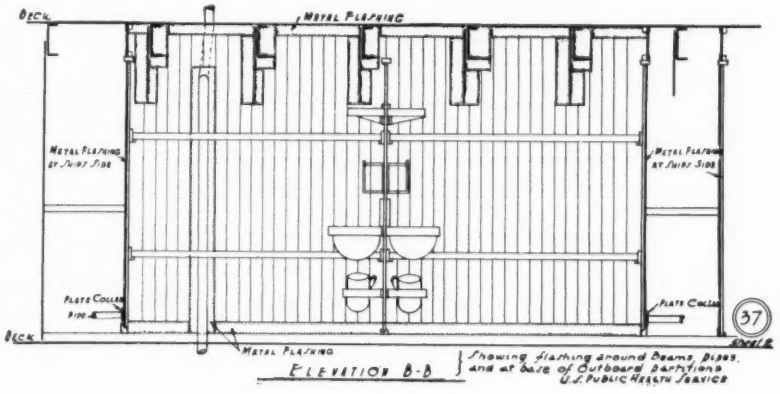
SKETCH SHOWING TYPICAL METHOD OF CLOSING UP DECK HEAD SPACES FOR PURPOSE OF RAT PROOFING SAME

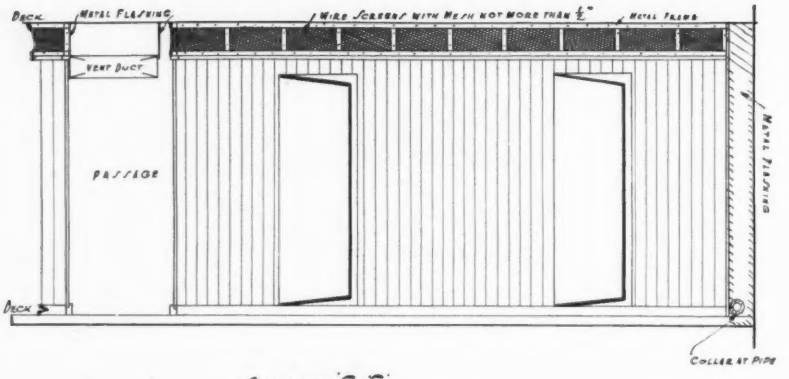
SKETCH SHOWING SERVICE BEHIND MAIN SALOON HALLWAYS &C. WITH UNFINISHED PARTITIONS AT DECK HEAD ALSO STEWARDS LINEN LOCKERS.

U.S. PUBLIC HEALTH SERVICE

35 and 36


FLASHING
WIRE MESH NOT MORE THAN ½"
No 12 OR No 16 GAUGE METAL FLASHING
DECK
VENT
VENT DUCT
PASSAGE
PASSAGE
DECK
ELEVATION A-A
U. S. PUBLIC HEALTH SERVICE
37
SHEET 1

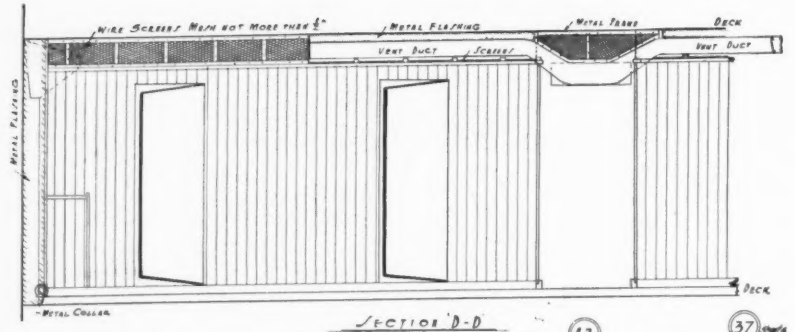

DECK
METAL FLASHING
METAL FLASHING AT SHIP SIDE
METAL FLASHING AT SHIP SIDE
PLATE COLLAR
PIPE
PLATE COLLAR
DECK
METAL FLASHING
ELEVATION B-B
Showing flashing around Beams, Pipes, and at base of Outboard Partitions
U. S. PUBLIC HEALTH SERVICE
37
SHEET 2



SECTION C-C

SHOWING SCREENING OVER PARTITIONS AND FLASHING OVER AIR DUCT

U.S. PUBLIC HEALTH SERVICE 37

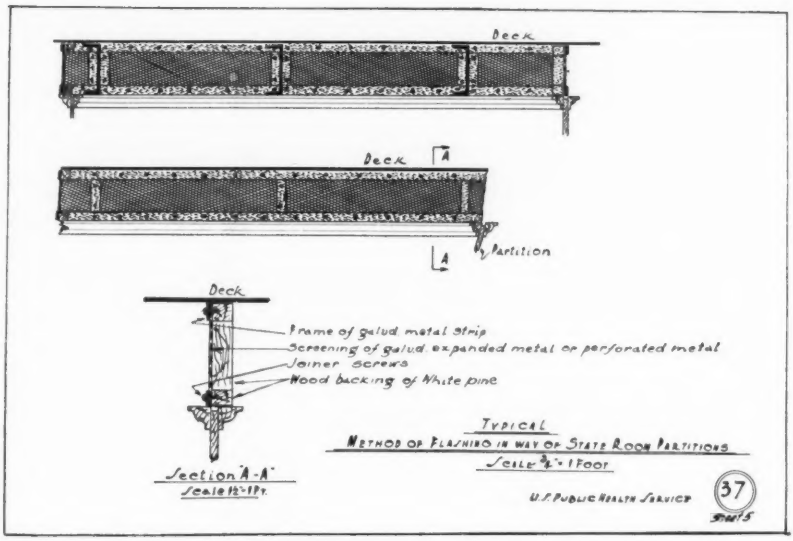


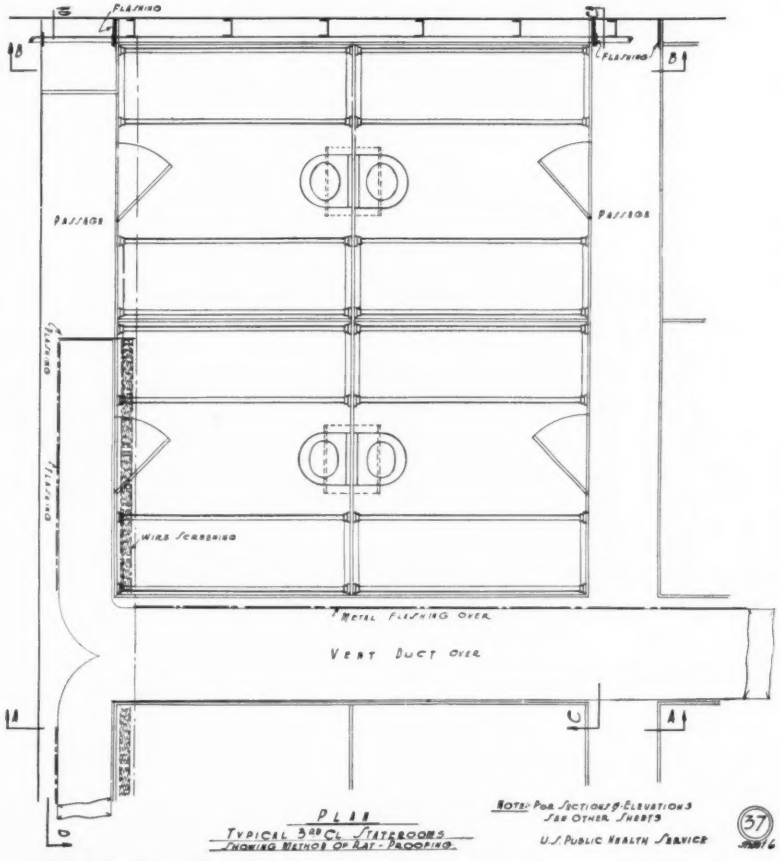
SECTION D-D

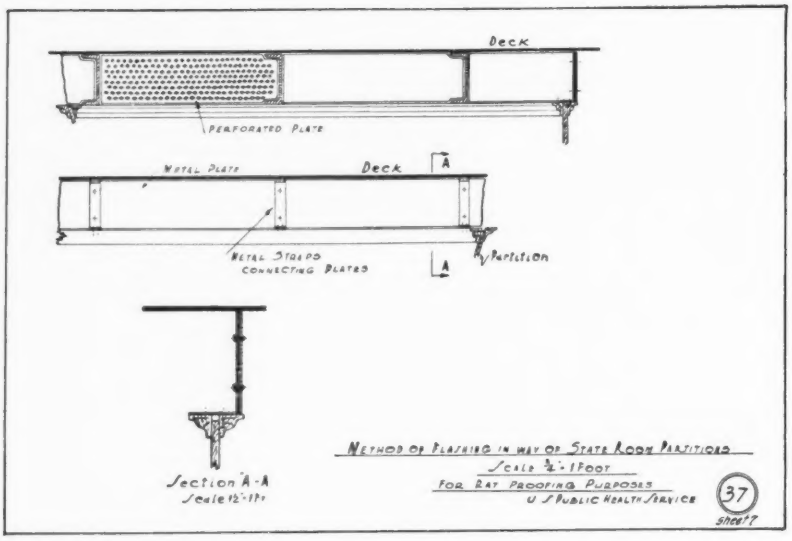
SHOWING FLASHING OVER AIR VENT DUCTS

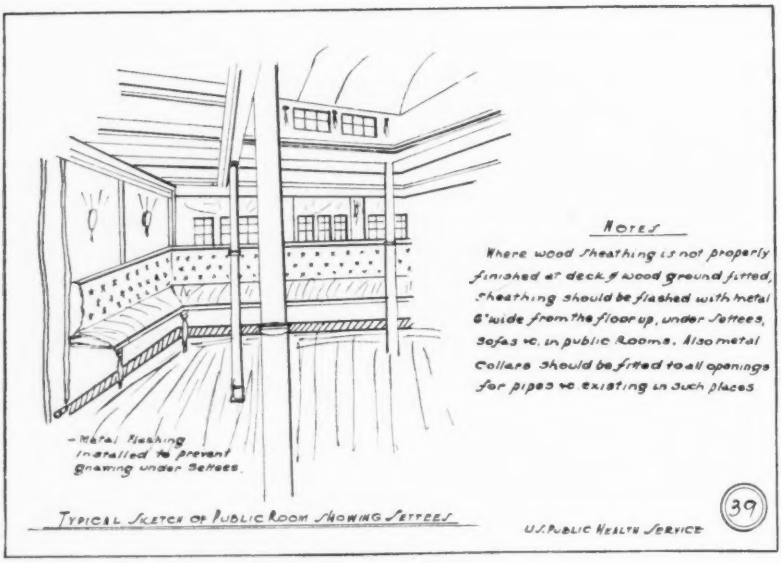
43

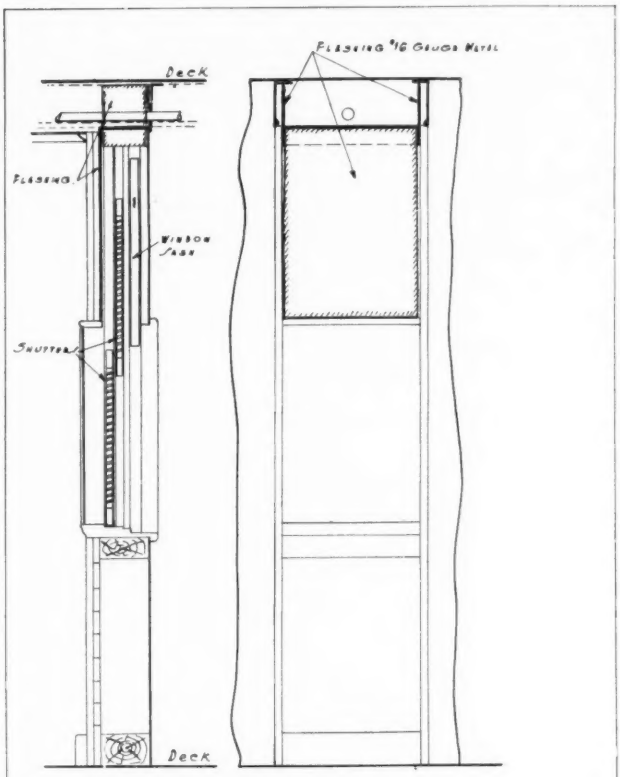
U.S. PUBLIC HEALTH SERVICE 37


Deck
Deck
A
A
Partition
Deck
Frame of galvd. metal strip
Screening of galvd. expanded metal or perforated metal
Joiner screws
Wood backing of White pine
Section A-A
Scale 12"=1 Ft.
TYPICAL
METHOD OF FLASHING IN WAY OF STATE ROOM PARTITIONS
Scale ¾"=1 Foot
U.S. PUBLIC HEALTH SERVICE
37
SHEET 5


FLASHING
FLASHING
B
B
PASSAGE
PASSAGE
WIRE SCREENING
METAL FLASHING OVER
VENT DUCT OVER
A
A
C
D
PLAN
TYPICAL 3RD CL. STATEROOMS
SHOWING METHOD OF RAT-PROOFING
NOTE: FOR SECTIONS & ELEVATIONS SEE OTHER SHEETS
U.S. PUBLIC HEALTH SERVICE
37
SHEET 6


Deck
Perforated Plate
Metal Plate
Deck
A
Metal Straps connecting Plates
Partition
A
Section "A-A
Scale 1½"-1ft
Method of Flashing in way of State Room Partitions
Scale ½"-1 Foot
For Rat Proofing Purposes
U.S. Public Health Service
37
sheet 7

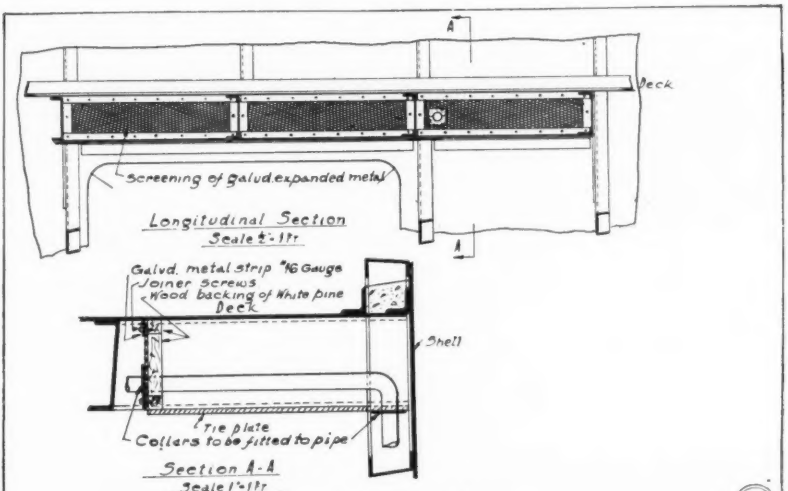

Metal flashing installed to prevent gnawing under settees.
Typical Sketch of Public Room showing Settees
Notes
Where wood sheathing is not properly finished at deck & wood ground fitted, sheathing should be flashed with metal 6" wide from the floor up, under settees, sofas &c. in public Rooms. Also metal collars should be fitted to all openings for pipes &c existing in such places.
39
U.S. Public Health Service



Sketch Showing Method of Flashing in Way of Ports to Cabins in Superstructure in Order to Rat Proof Same

U.S. Public Health Service

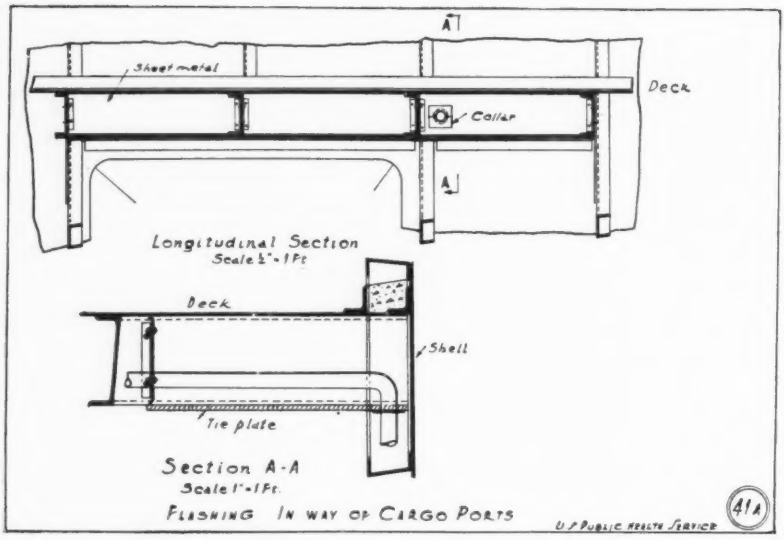
40

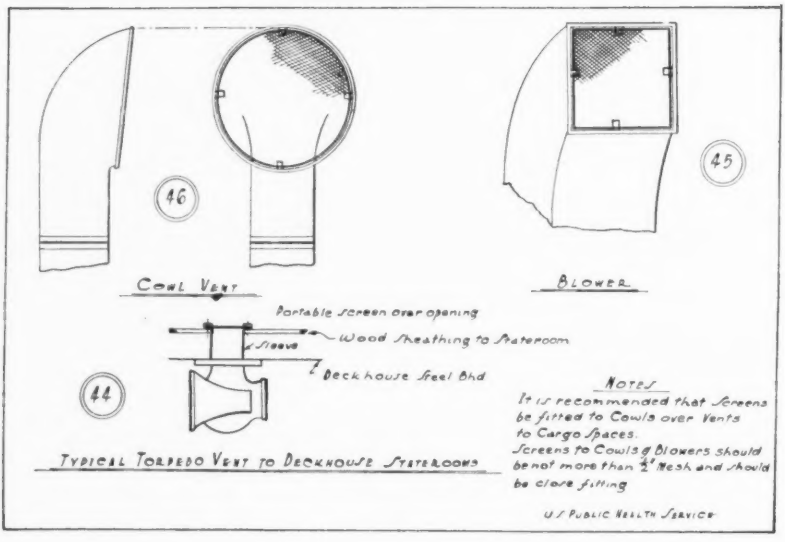


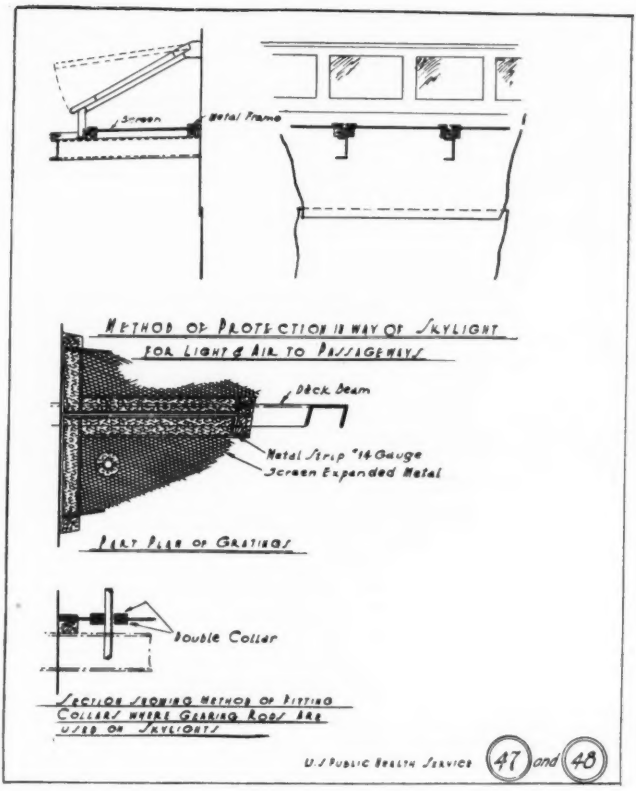
Flashing in Way of Cargo Ports

U.S. Public Health Service

41


A
Sheet metal
Deck
Collar
A
Longitudinal Section
Scale ½"-1Ft
Deck
Shell
Tie plate
Section A-A
Scale 1"-1Ft
FLASHING IN WAY OF CARGO PORTS
U.S. PUBLIC HEALTH SERVICE
41A


46
45
COWL VENT
BLOWER
Portable screen over opening
Wood Sheathing to Stateroom
Sleeve
Deckhouse Steel Bhd
44
TYPICAL TORPEDO VENT TO DECKHOUSE STATEROOMS
NOTES
It is recommended that Screens be fitted to Cowls over Vents to Cargo Spaces.
Screens to Cowls & Blowers should be not more than ½" Mesh and should be close fitting
U.S. PUBLIC HEALTH SERVICE

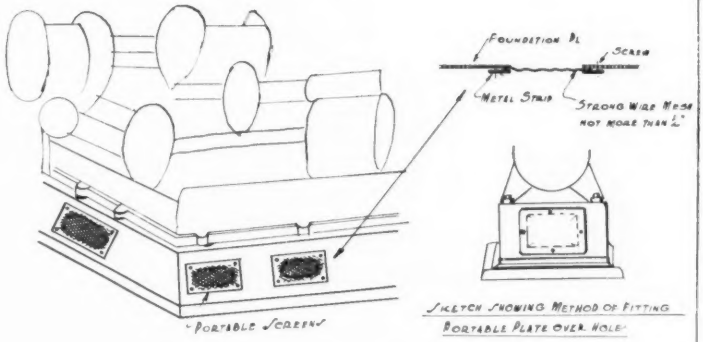


METHOD OF PROTECTION IN WAY OF SKYLIGHT FOR LIGHT & AIR TO PASSAGEWAYS

PART PLAN OF GRATINGS

SECTION SHOWING METHOD OF FITTING COLLARS WHERE GEARING RODS ARE USED ON SKYLIGHTS

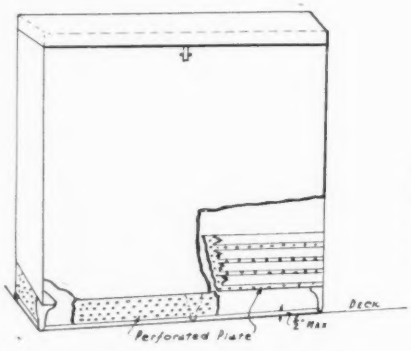
U.S. PUBLIC HEALTH SERVICE 47 and 48



SKETCH SHOWING METHOD OF FITTING PORTABLE PLATE OVER HOLE

TYPICAL SKETCH OF FOUNDATION FOR DECK MACHINERY, MOTOR BASES ETC SHOWING METHOD OF CLOSING HOLES WHICH GIVE ACCESS TO RAT HARBORAGE

U.S. PUBLIC HEALTH SERVICE 49



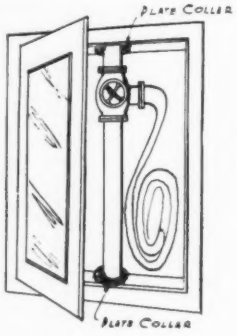
TYPICAL SKETCH OF LIFEBELT LOCKER, &c
SHOWING METHOD OF RATPROOFING

NOTES

Perforated Plate should be fitted all around Front, Back & Sides at bottom, ½" Max. distance from Deck to allow free run of water.
Where wood spars are fitted inside at bottom as shown, a perforated galvd metal plate should be fitted

U.S. PUBLIC HEALTH SERVICE

50



FIRE-HOSE BOX

When Wood Fire Hose Box is fitted as shown, it is important that pipe be properly collared. It is desirable that these Boxes be made of Metal with Doors Eliminated

FIRE HOSE LOCKER

These lockers should be properly finished inside, and made tight fitting, care being taken that all holes are blocked and Collars fitted to prevent rats getting access to other parts of ship.

U.S. PUBLIC HEALTH SERVICE

51

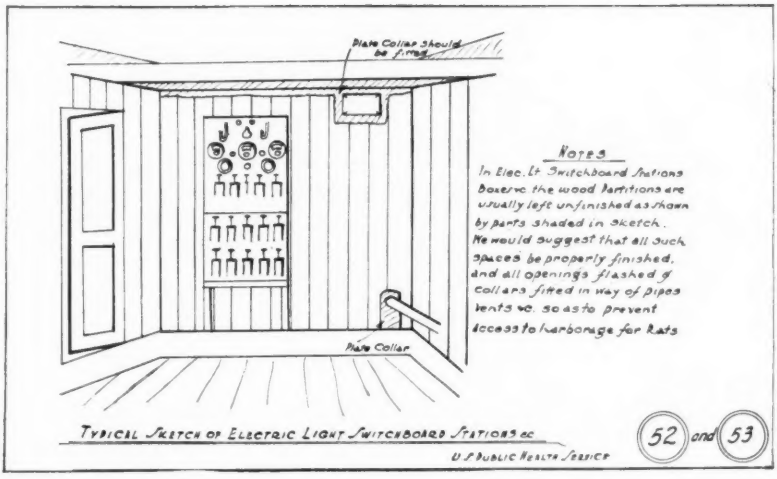
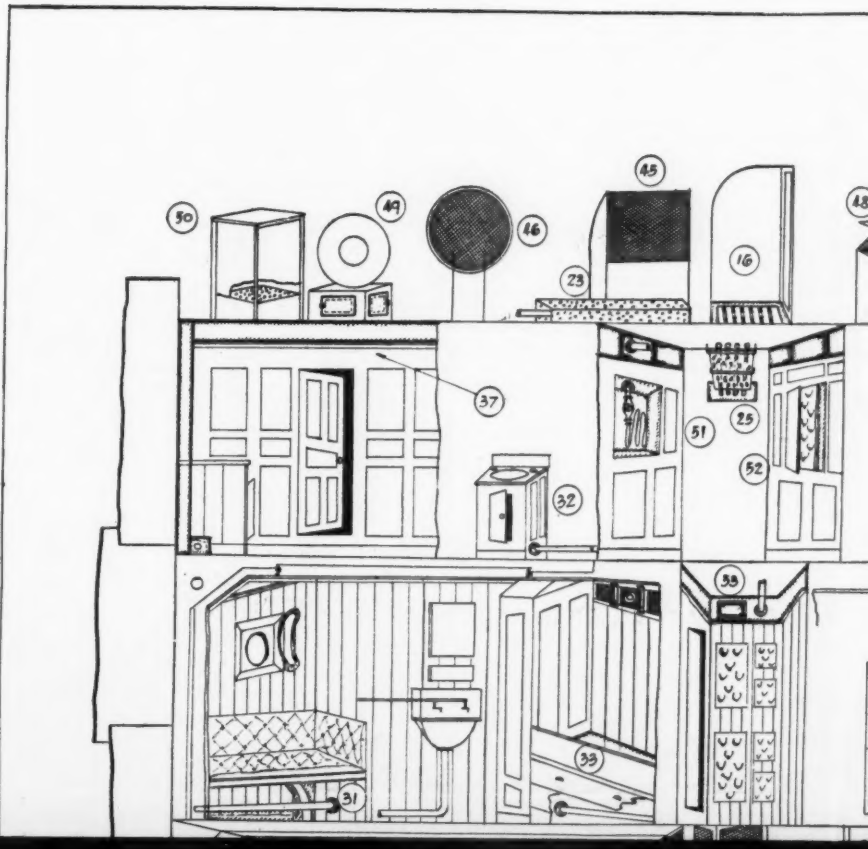


Plate Collar should be fitted
Plate Collar
Notes
In Elec. Lt Switchboard Stations Boatsetc the wood Partitions are usually left unfinished as shown by parts shaded in Sketch. We would suggest that all such spaces be properly finished, and all openings flashed & collars fitted in way of pipes vents etc. so as to prevent access to harbourage for Rats
Typical Sketch of Electric Light Switchboard Stations &c
U.S. Public Health Service
52 and 53

The drawing reproduced on the opposite page presents a perspective cross section of a vessel showing typical examples of finished rat-proofing work recommended to be done in the various sections and compartments.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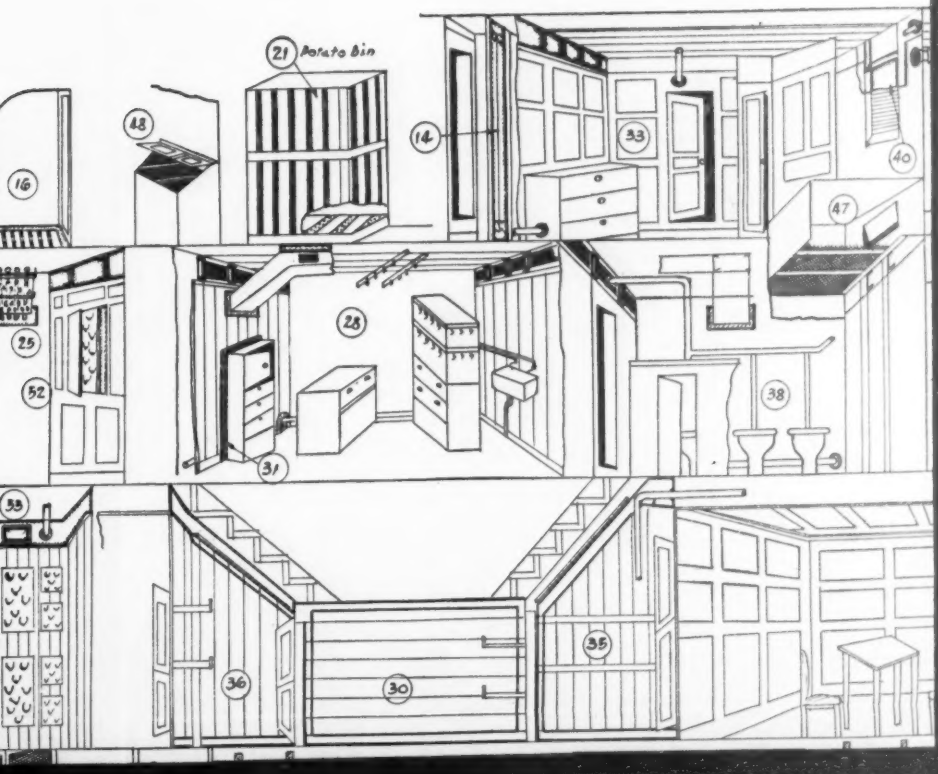
21 Potato Bin
48
14
33
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21 Potato Bin
48
14
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44
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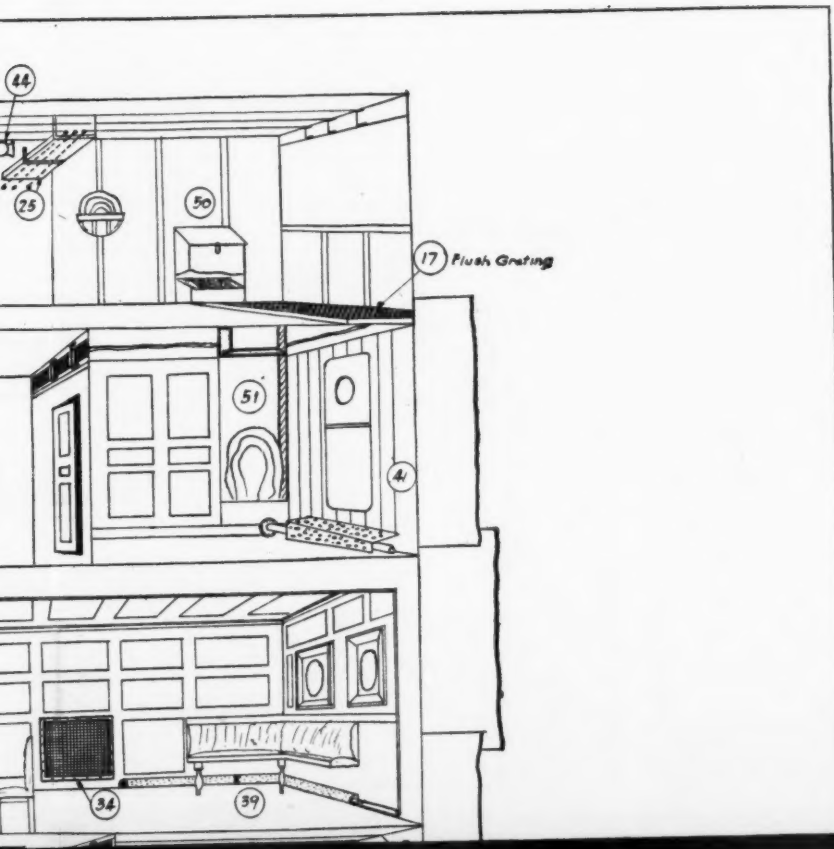
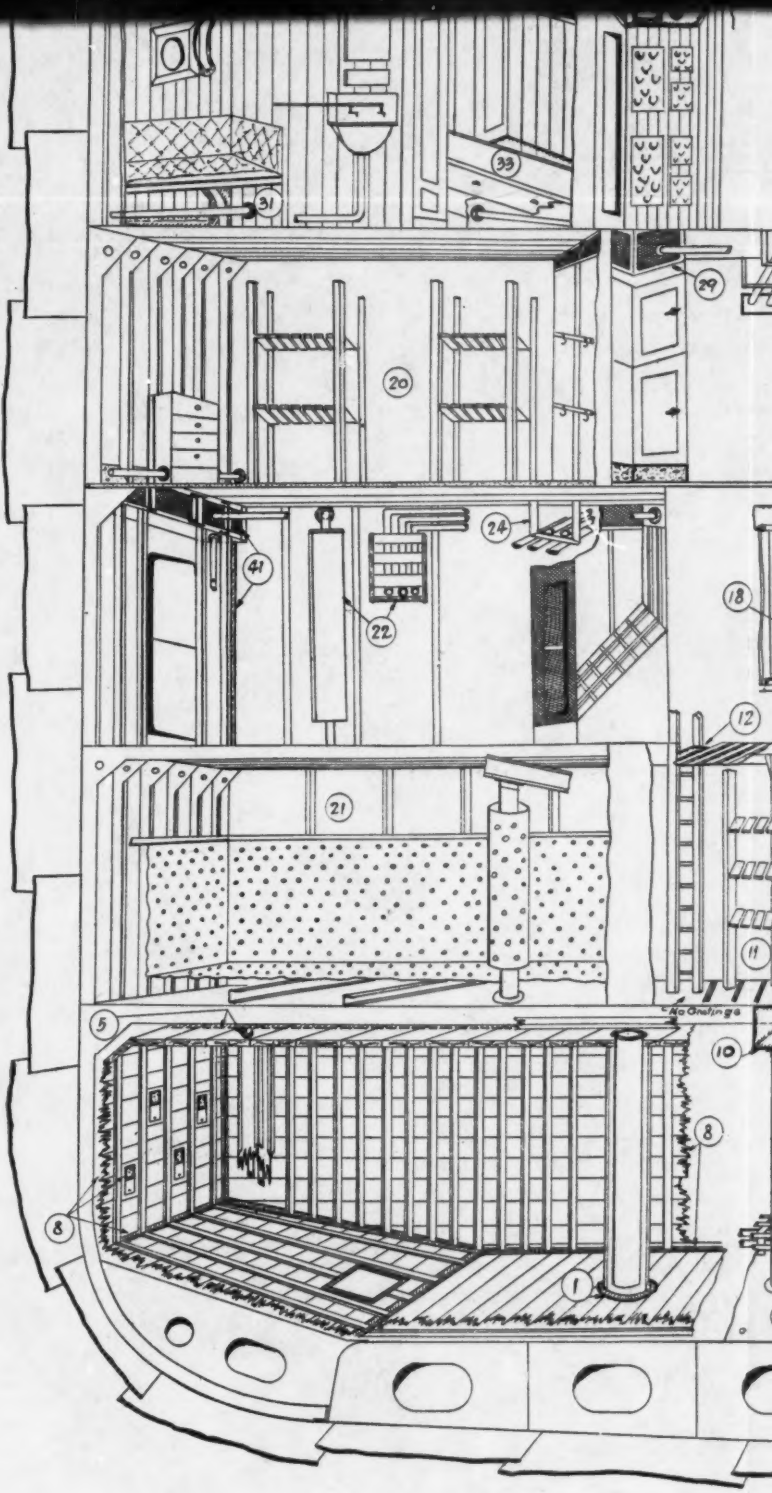

44
25
50
17 Plush Grating
51
41
34
39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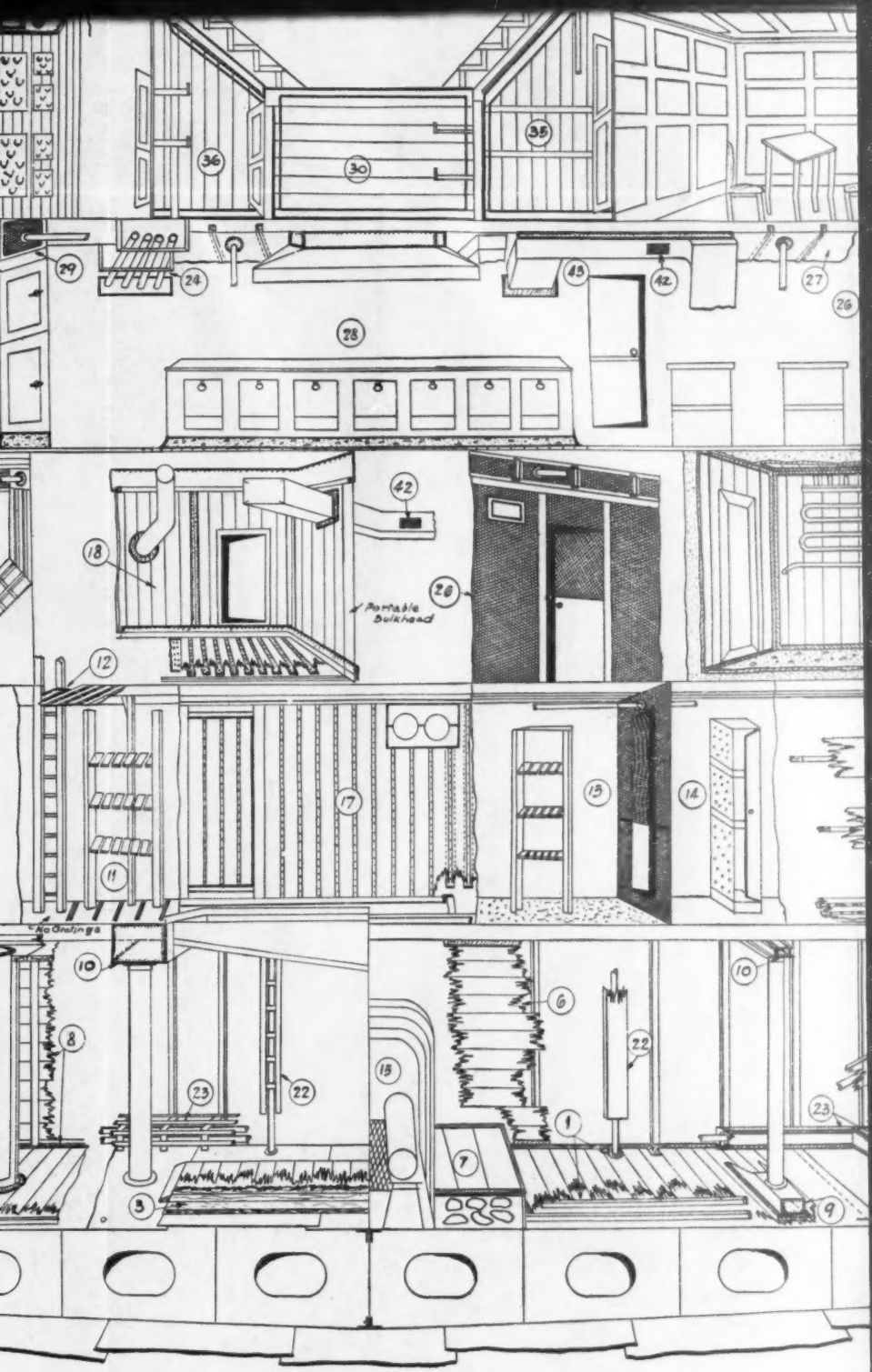
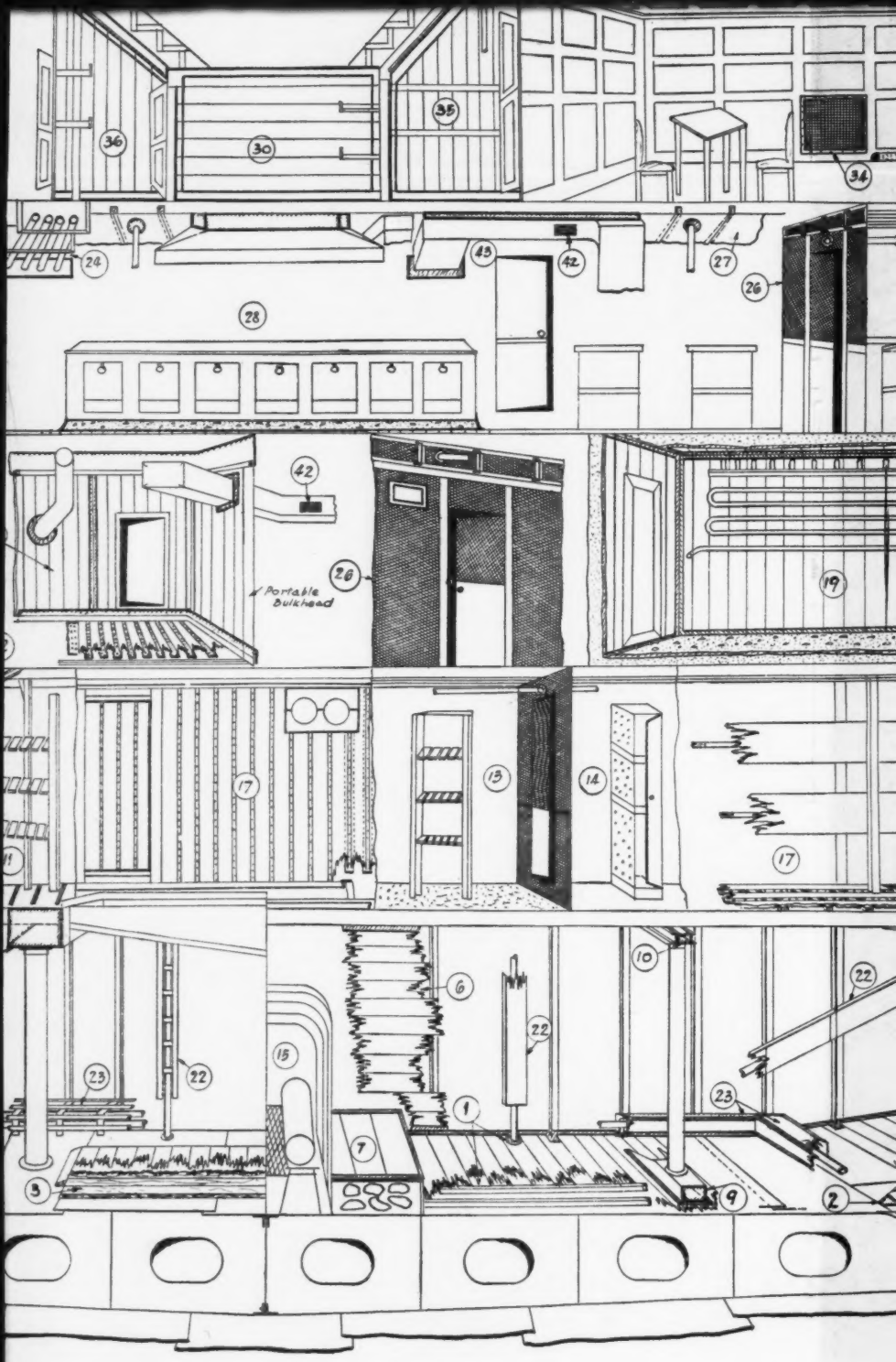


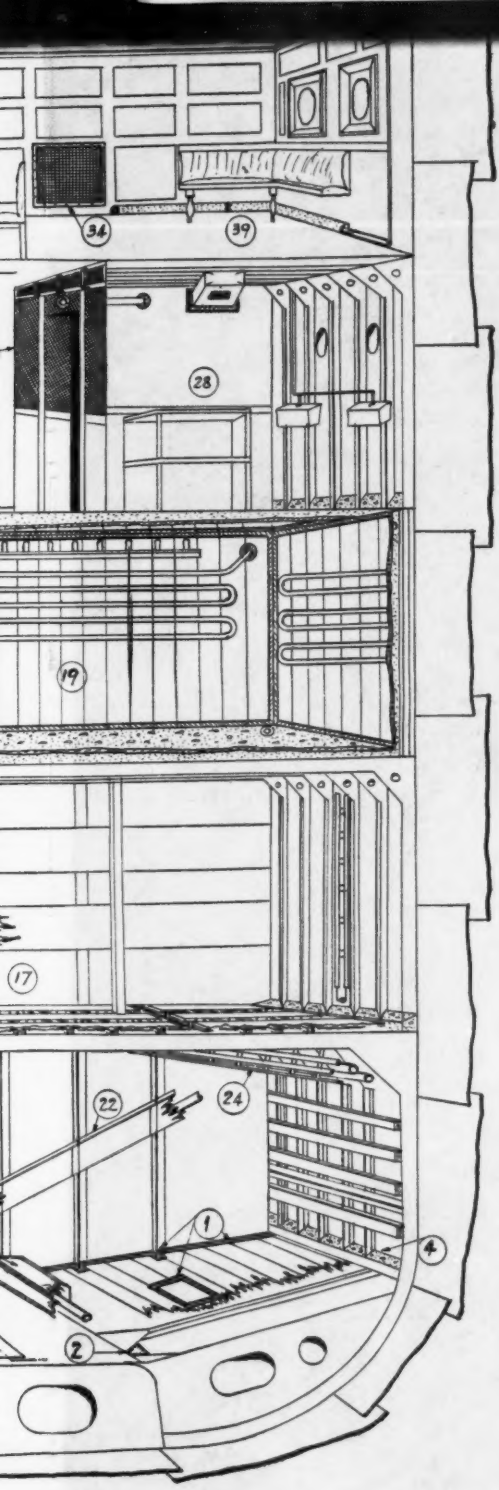
PERSPECTIVE VIEW OF CROSS SECTION OF SHIP

SHOWING IN A COMPOSITE MANNER EXAMPLES OF TYPICAL RAT-PROOFING WORK RECOMMENDED TO BE DONE IN THE VARIOUS SECTIONS AND COMPARTMENTS.

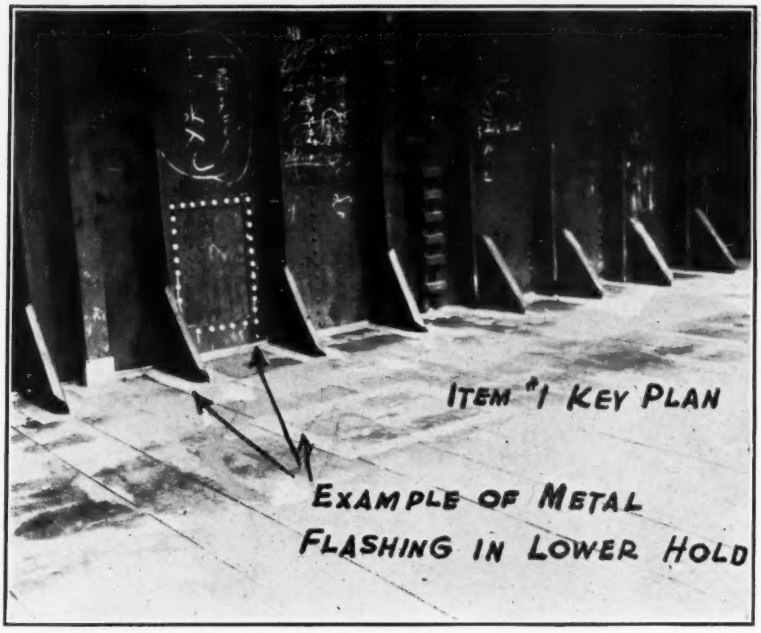


PERSPECTIVE VIEW OF CROSS SECTION OF SHIP

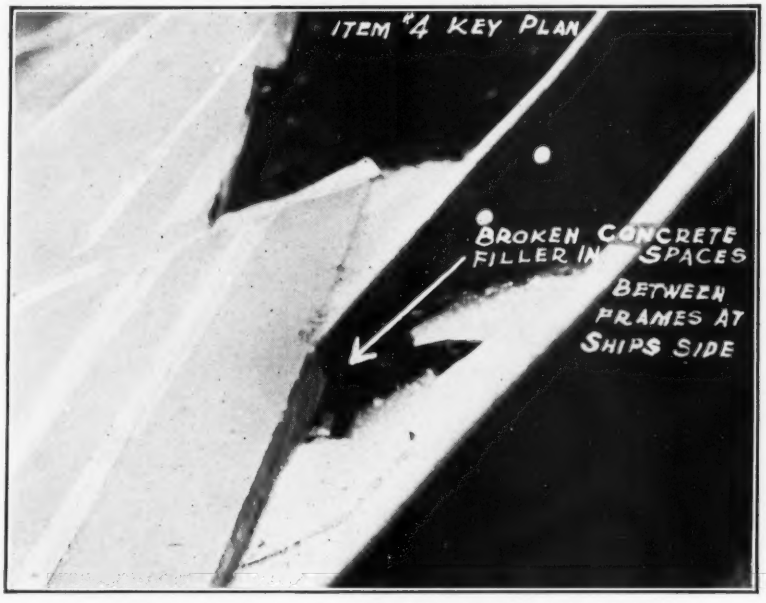
SHOWING IN A COMPOSITE MANNER EXAMPLES OF TYPICAL RAY-PROOFING WORK RECOMMENDED TO BE DONE IN THE VARIOUS SECTIONS AND COMPARTMENTS.



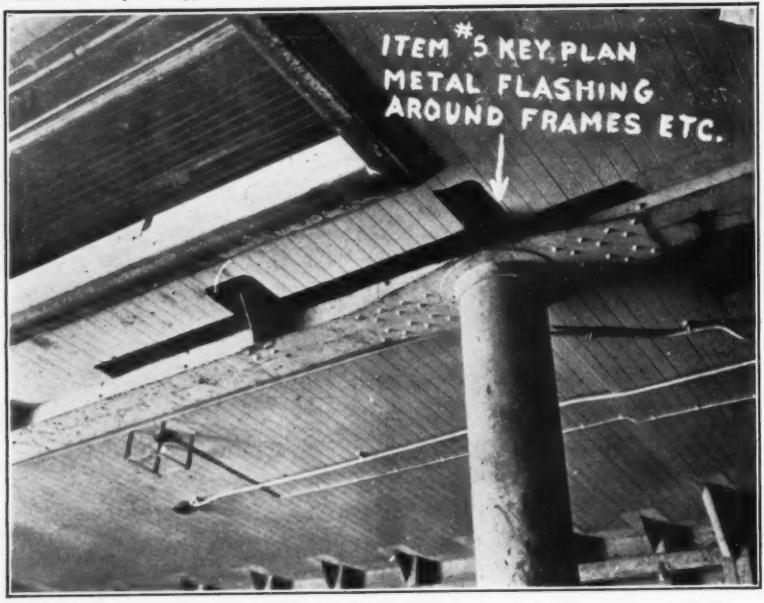
U.S. PUBLIC HEALTH SERVICE



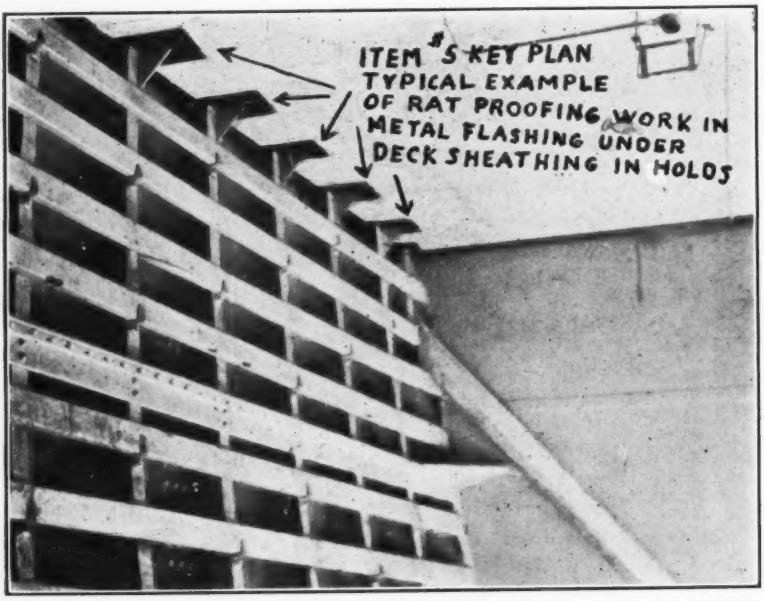
METAL FLASHING AROUND EDGES OF CEILING BOARDS IN LOWER HOLD



CLOSE UP VIEW OF HOLE IN BROKEN CONCRETE FILLER



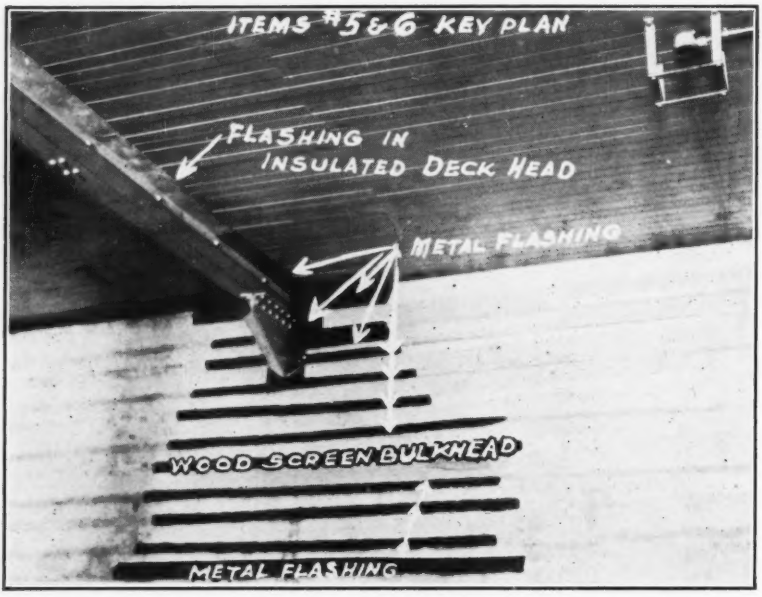
METAL FLASHING INSTALLED ON UNDER-DECK SHEATHING IN HOLDS



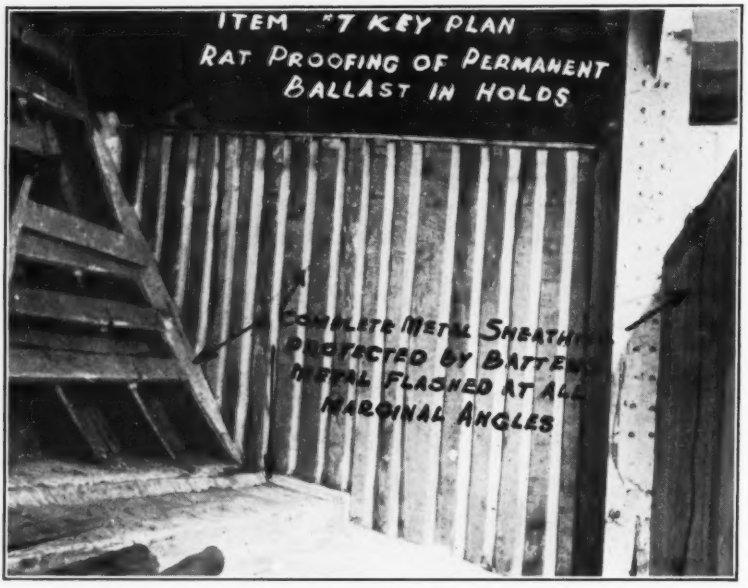
METAL FLASHING FITTED AROUND STRUCTURAL BEAMS IN HOLDS WHERE UNDERDECK SHEATHING HAS BEEN INSTALLED

A VIEW SHOWING THE EXTENT TO WHICH THE SPACE BEHIND SCREEN BULKHEADS IS USED FOR NESTING

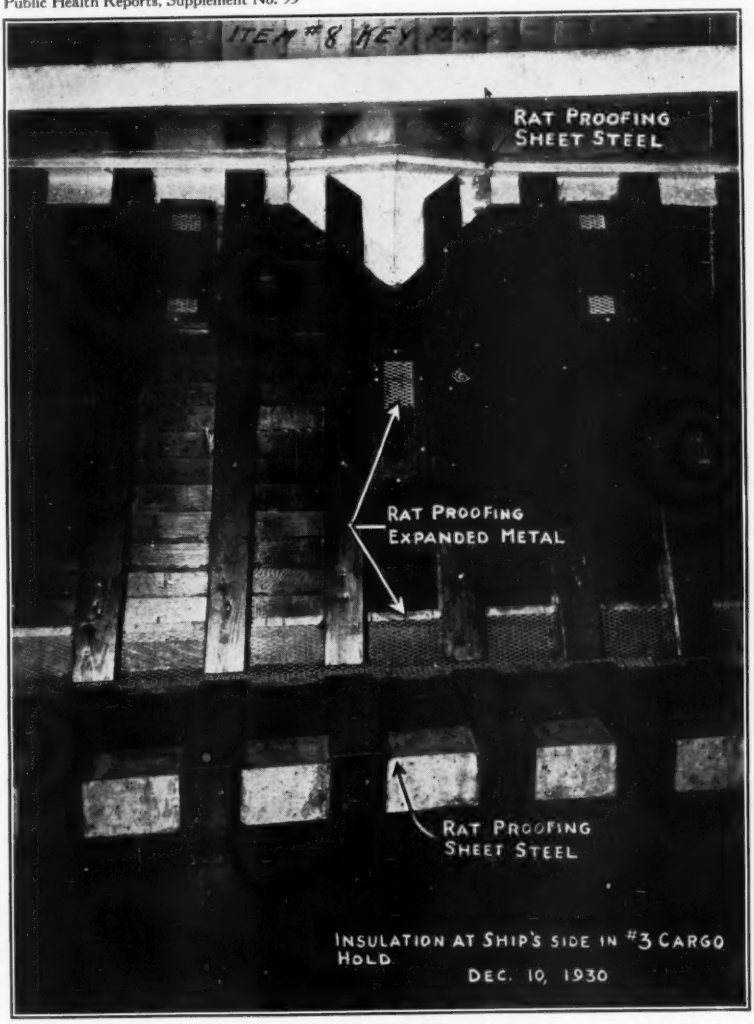
EXAMPLE OF METAL FLASHING OF SCREEN BULKHEAD



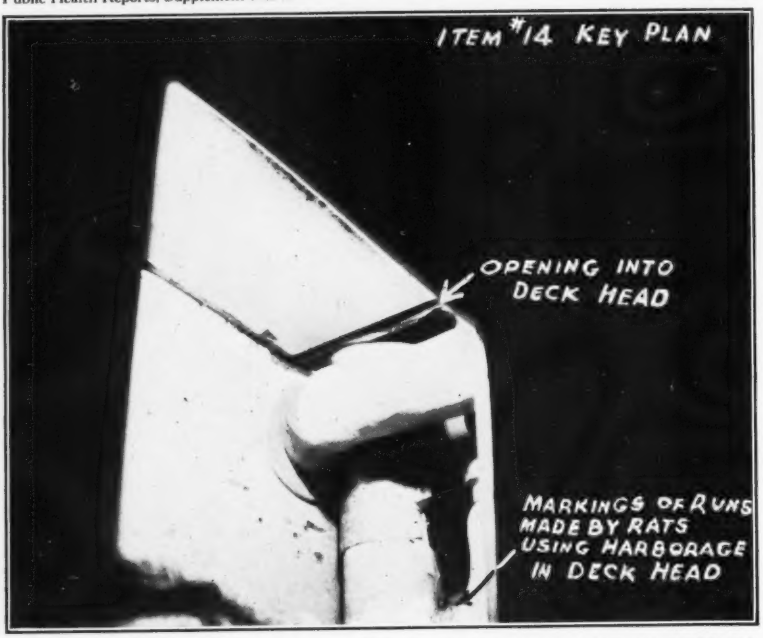
EXAMPLE OF METAL FLASHING OF SCREEN BULKHEAD AND INSULATED DECK HEAD IN HOLDS



CORRECTION OR HARBORAGE IN PERMANENT ROCK OR OTHER BALLAST IN HOLDS

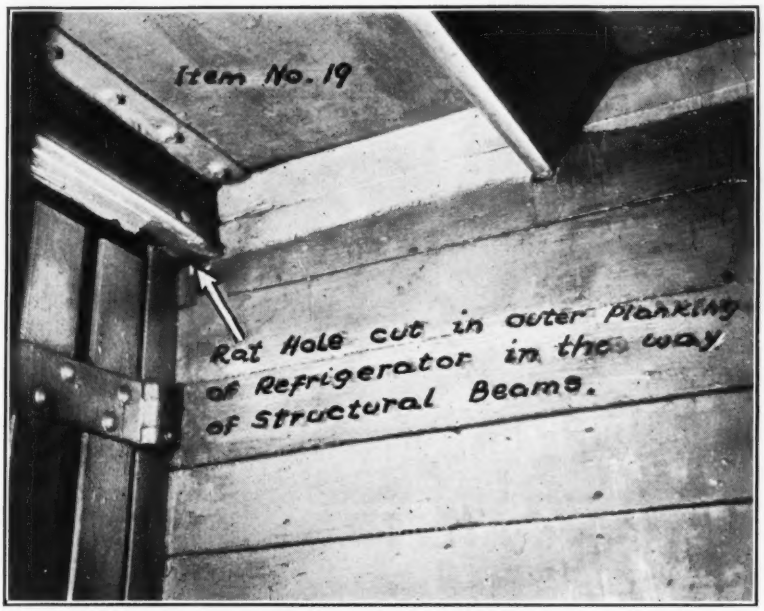


INSTALLATION OF PROTECTIVE RAT-PROOFING WORK IN AIR-COOLED AND INSULATED CARGO HOLDS



RAT HARBORAGE IN DECK HEAD OVER STEWARDS' LOCKERS IN PASSAGE WAYS

RAT PROOFING WORK DONE TO CORRECT CONDITIONS IN STEWARDS' LOCKERS

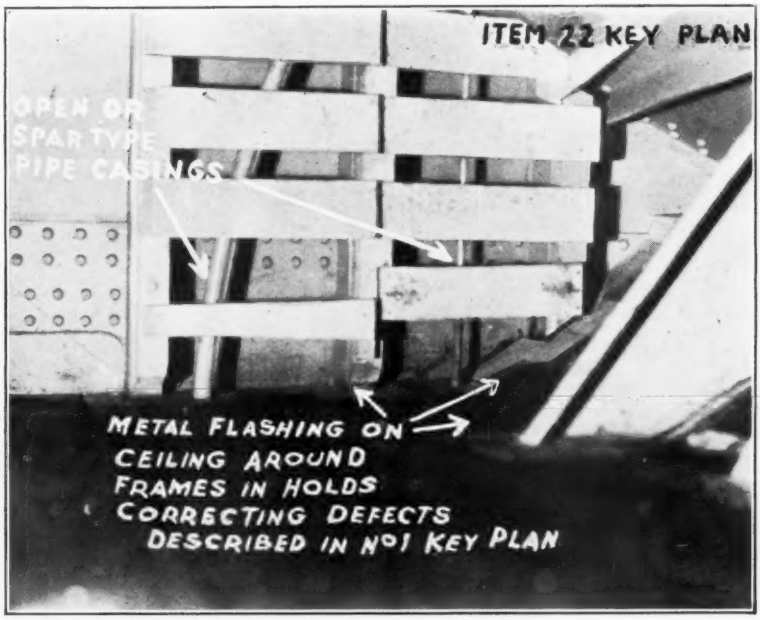


RAT HOLE CUT IN OUTER WOODEN SHEATHING OF REFRIGERATOR ALONGSIDE OF A STRUCTURAL BEAM

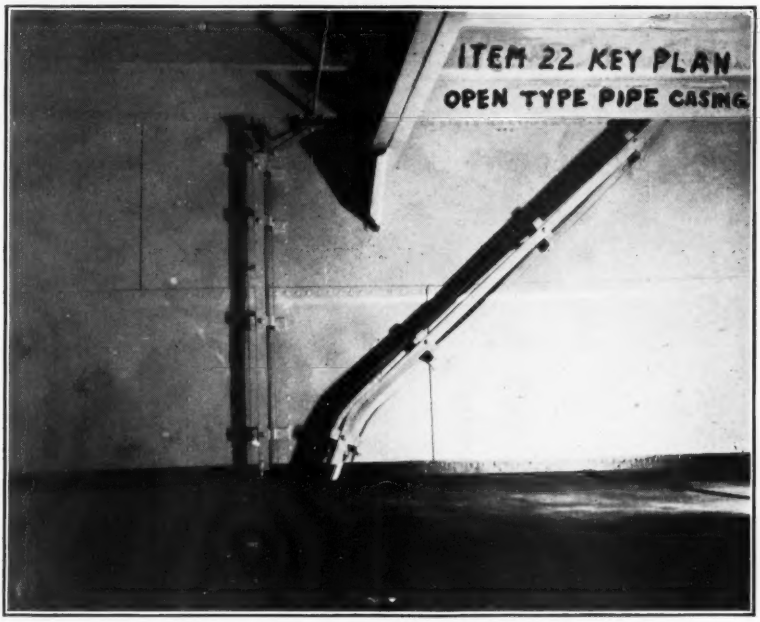
METAL FLASHING OF EXTERIOR WOODEN WALLS OF REFRIGERATOR

RAT PROOFING EXPANDED METAL
RAT PROOFING SHEET STEEL
ITEMS #20 & 26 KEY PLAN
RAT PROOFING EXPANDED METAL
STEWARD'S STORES ON MAIN DECK
DEC. 10, 1930

EXAMPLES OF INSTALLATION OF PROTECTIVE SCREENS AND METAL COLLARS

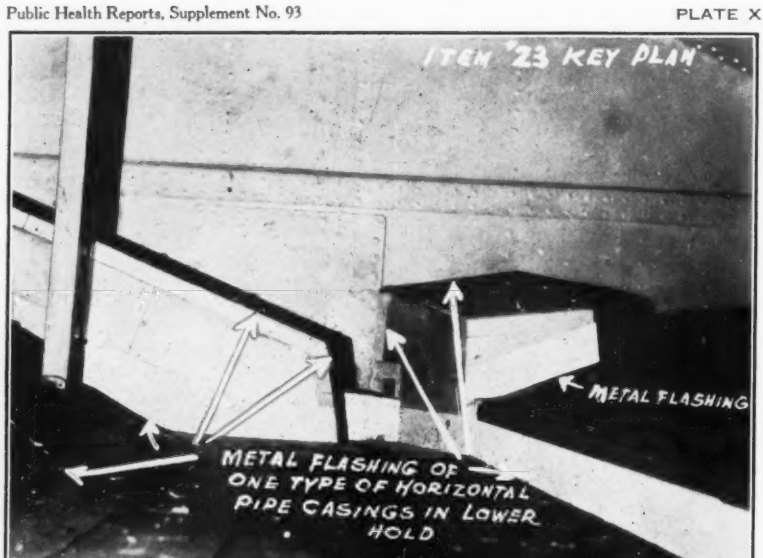


BOXED VERTICAL PIPE CASINGS WHICH HAVE BEEN CHANGED TO THE OPEN, OR SPAR, TYPE



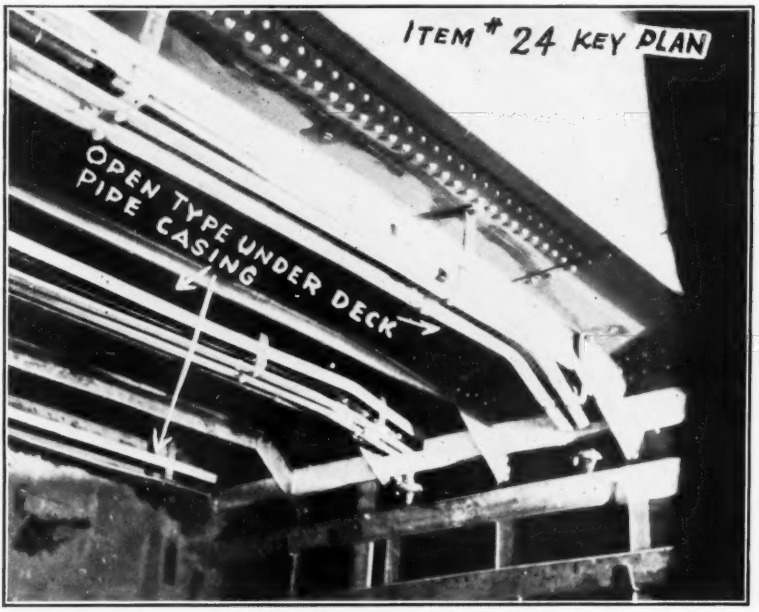
TYPE OF OPEN VERTICAL PIPE CASING RECOMMENDED FOR NEW CONSTRUCTION

45507°—31——6

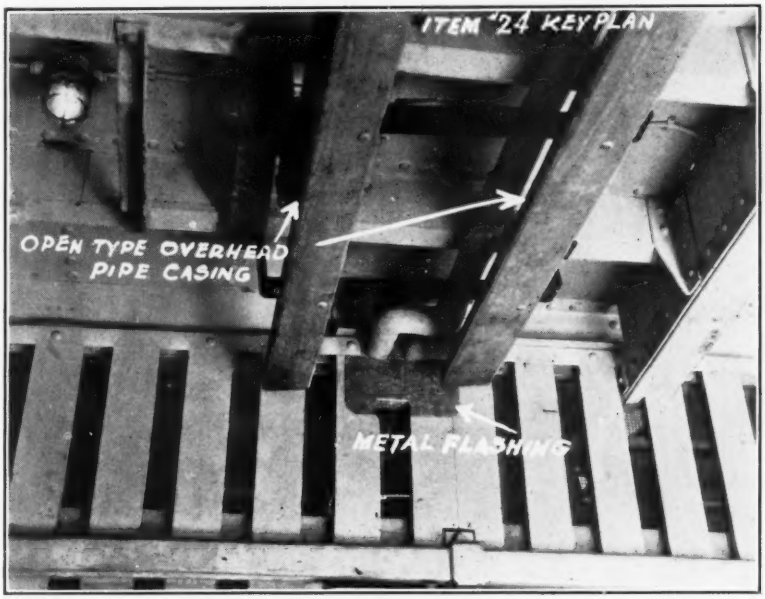


METAL FLASHING OF BOXED HORIZONTAL PIPE CASINGS IN LOWER HOLD

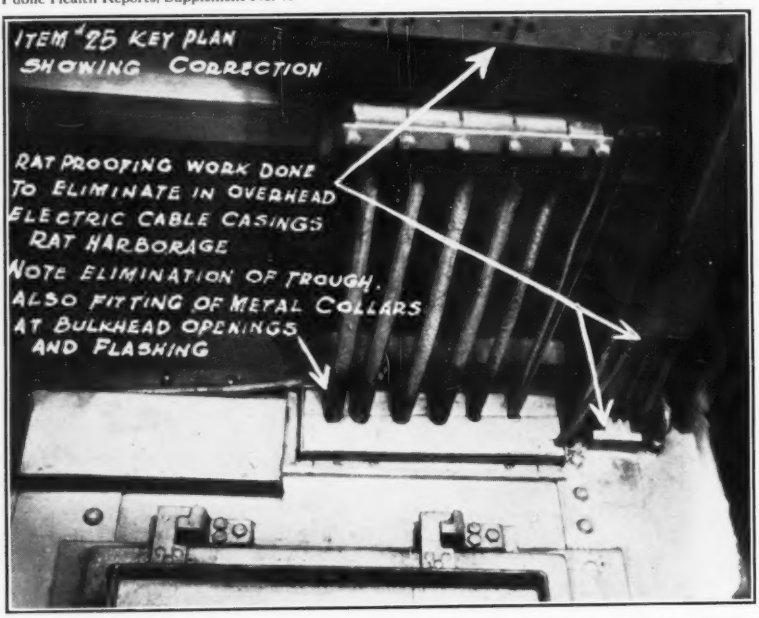
OPEN TYPE OF HORIZONTAL PIPE CASINGS ON OUTBOARD SIDE OF HOLD RECOMMENDED FOR NEW CONSTRUCTION



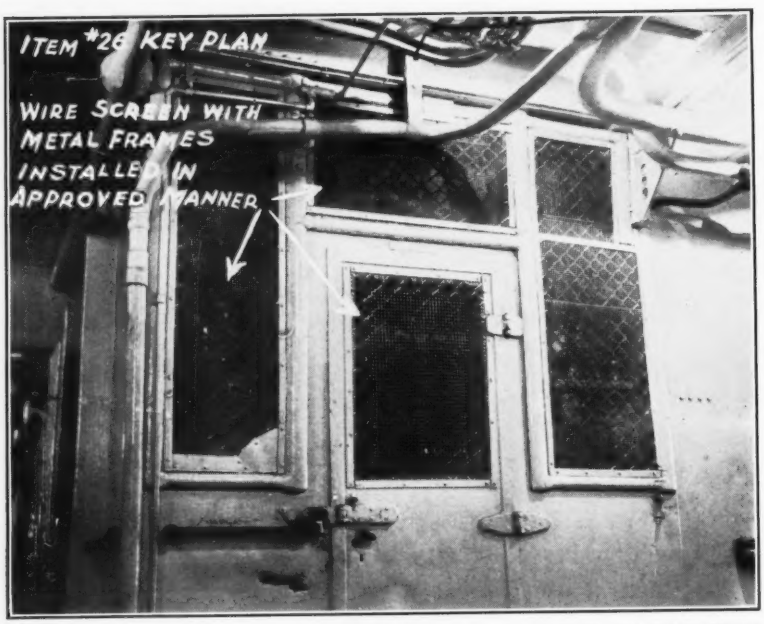
OPEN TYPE UNDER-DECK PIPE CASING WHICH REPLACED THE CLOSED BOXED STYLE CASING



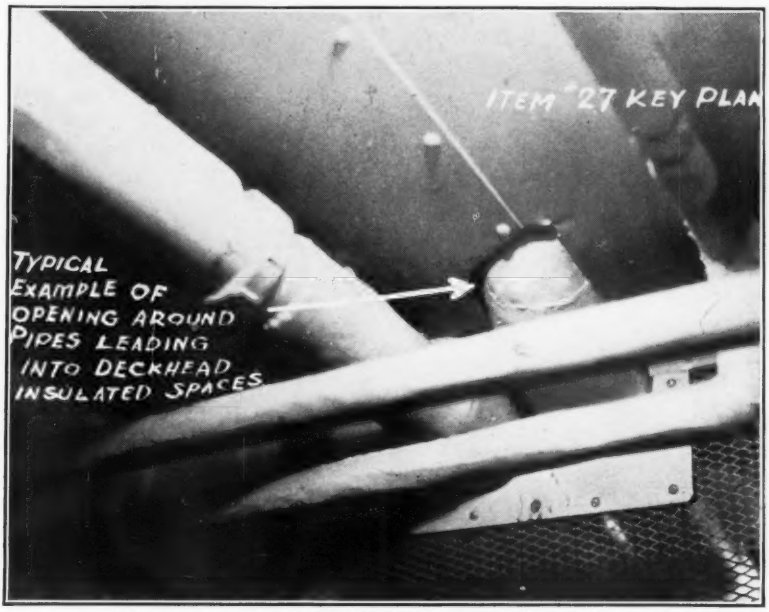
ANOTHER EXAMPLE OF OVERHEAD OPEN TYPE PIPE CASING REPLACING AN IRON TROUGH CASING



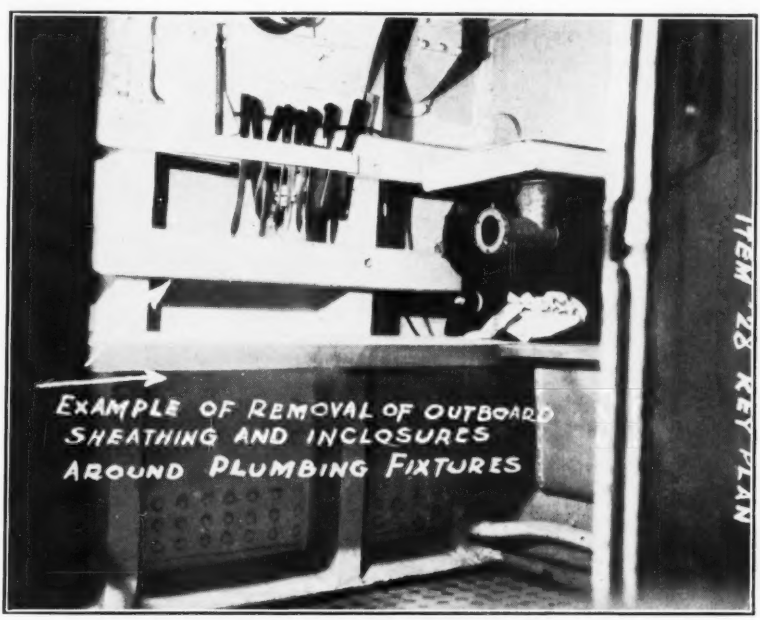
ONE TYPE OF CORRECTIVE RATPROOFING WORK WHERE ELECTRIC CABLES, ETC., PASS THROUGH BULKHEADS



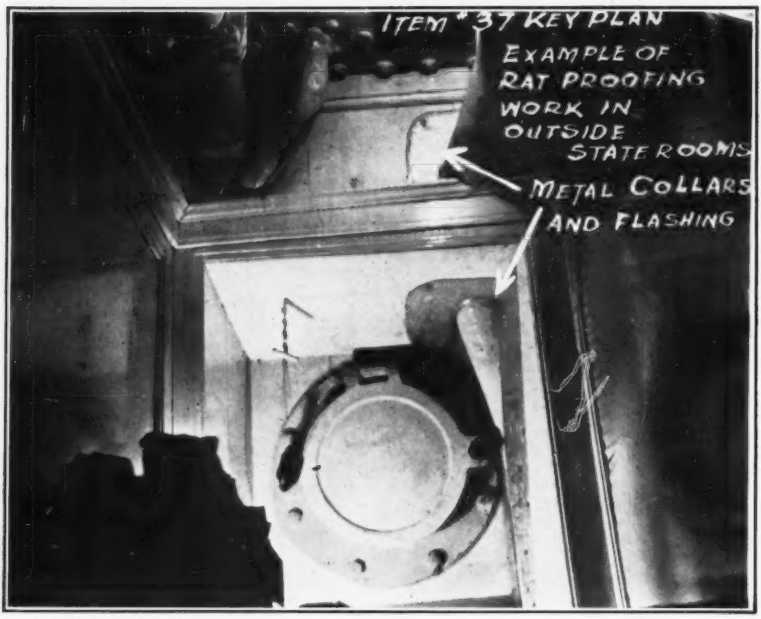
SATISFACTORY MANNER OF INSTALLING WIRE SCREENS ON PARTITION BULKHEADS



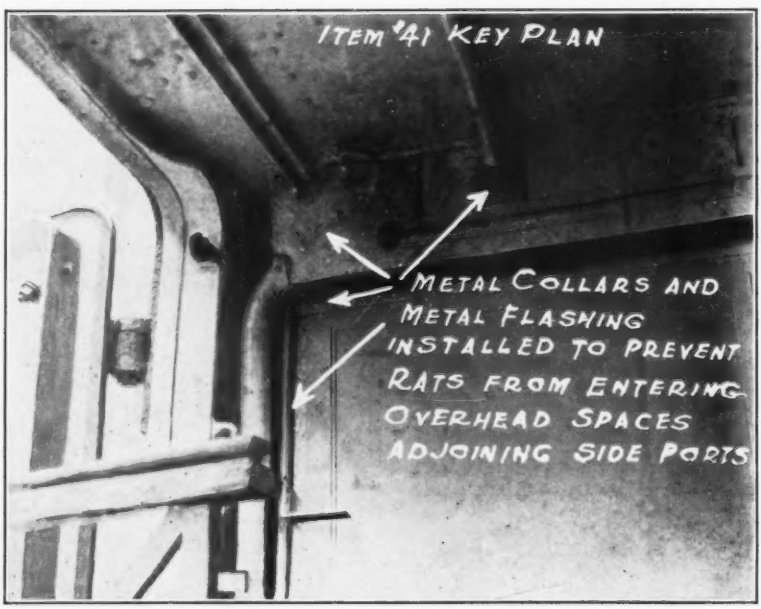
ANOTHER EXAMPLE OF DEFECTS IN DECKHEAD SHEATHING



RAT PROOFING WORK DONE IN BUTCHER SHOP



EXAMPLES OF CLOSING OPENINGS AROUND PIPES IN OUTSIDE STATEROOMS


ITEM #41 KEY PLAN
METAL COLLARS AND METAL FLASHING INSTALLED TO PREVENT RATS FROM ENTERING OVERHEAD SPACES ADJOINING SIDE PORTS

EXAMPLE OF RAT-PROOFING WORK AROUND SIDE PORTS

Appendix

SUGGESTIONS IN CARRYING OUT AND MAINTAINING RAT-PROOFING WORK ON BOARD VESSELS [1]

1. The principles and purposes of rat proofing, as well as the method of carrying it out, should be explained in a general circular addressed to the commanders and junior officers of your fleet.

2. Such officers should be required to familiarize themselves with this subject and in a general way be able to detect defects and conditions which are, or are likely to become, rat harborages, and to have some knowledge of the way in which such harborage can be eliminated or defective conditions corrected.

3. The officers as well as marine superintendents should be supplied with copies of the publication, The Rat Proofing of Vessels, issued by the United States Public Health Service as Supplement No. 93, and General Instructions for Rat Proofing of Ships, American Marine Standard No. H–41 1929, issued by the American Marine Standards Committee, United States Department of Commerce.

4. These booklets will give the general idea of rat proofing as well as detailed specifications for accomplishing the work. A careful perusal and study of these publications is recommended, for such will serve to arouse the officers' interest in this matter. They will understand that the principles of rat proofing are based on biological facts as well as a thorough knowledge of rat psychology and habits.

5. Attention of officers and personnel of your ships should be called to the fact that in order to get the best and most permanent results from rat proofing, it is necessary to have their full, intelligent, and whole-hearted cooperation. They should be urged to observe and report to their proper chief any sign or evidence of rat life and activity; also open spaces or defects which may serve as harborage, with such detail as to location, etc., as they may be able to give. These reports should be tabulated and copies furnished to the quarantine officials at the various ports of call, particularly the terminal and home ports.

6. Rat-proofing work in order to be permanently effective must be kept intact and in good condition. For this reason inspection of it should be included in the regular ship's inspection and a report of its condition made and kept by a responsible officer designated for this purpose. Defects noted should be corrected by the proper mechanical force upon the ship's arrival in its home or other ports.

[1] Text of circular sent by the Public Health Service to steamship companies.

This upkeep is very important and must not be neglected, for it is absolutely essential to the maintenance of efficiency.

7. Several persons possessing the necessary qualifications should be thoroughly trained in the theoretical and practical sides of this matter, for the purpose of serving as inspectors at your home ports. These men, could, after they have acquired experience, cover each ship while in port.

8. Naval constructors, marine and engineering superintendents, and your ships' repair force should be instructed that all work involving alterations and structural changes should carry out the rat-proofing idea, so that the mistakes of the past which have resulted in the creation of rat harborages may be avoided. They should be further instructed that when any repairs are made to sections or compartments of the ships which have been already rat proofed, the metal collars, screens, etc., be replaced in good condition as soon as the repairs which occasioned their removal have been completed.

9. Dunnage and material such as mats used in holds to protect cargo play an important rôle in providing rat harborage and nesting places, especially when used in excessive quantities. Officers and crews in immediate charge of cargo holds should be instructed to have all surplus and unserviceable dunnage removed from the holds. Old parts of gear, rope ends, etc., should be promptly disposed of and not allowed to accumulate in corners and out-of-the-way places in the holds.

10. Satisfactory rat control can be obtained by well planned and properly executed work, and this is possible only when its character and purpose are understood. The maintenance of the efficiency of this control is contingent on the proper upkeep of the work after its installation and of satisfactory conditions as set forth in item 8.

11. The purpose of rat proofing a vessel is to bring about a rat-free condition, so far as rat colony life is concerned, and the real test of its efficiency is whether it does just that.

12. The continued presence of a number of rats in any section of a ship would indicate that the rat-proofing work in that section is either incomplete or is defective and that corrective measures are required, just as leaks in the deck ceiling or water in the holds indicate the necessity of calking the decks or refastening the rivets on the plates.

TYPICAL LETTER ISSUED TO MASTERS OF VESSELS BY OPERATING OFFICIALS

RAT PROOFING

On completion of the rat proofing of your vessel your attention is called to the necessity for strict supervision in the upkeep of all details of the rat-proofing installation.

In order to obtain the best and most permanent results from rat proofing, the full cooperation of all your officers and engineers is of prime importance.

We are handing you United States Public Health Service Reprint Number 1030 entitled "The Rat Proofing of Vessels," together with the "Rat Proofing of Ships," general instructions issued by the American Marine Standards Committee, Department of Commerce. These two booklets [2] explain in detail the method of rat proofing vessels, and are to be available to all your officers and engineers for their careful study. A perusal of these booklets will undoubtedly arouse in your officer personnel the necessary interest in this matter, which is the object of these instructions. The booklets also explain that the principles of rat proofing are based on biological facts, together with a knowledge of rat psychology and habits.

Our observations during the period the vessels of our fleet have been undergoing rat-proof installation, disclose the fact that a great deal of education is necessary among the officer personnel in order to convince them of manifold advantages accruing to a rat-proofed vessel. Without a full knowledge of these advantages, the close cooperation of your officers necessary to keep your vessel in the high state of rat-proofed efficiency that we desire, will be lacking.

Most of the officers under your command are familiar with rat-proofing requirements, due to the fact that they have been actively engaged in the installation of the rat proofing of your vessel. It is particularly requested that new officers joining the company's service be given every opportunity to familiarize themselves with every detail of rat proofing.

Rat-proofing work, in order to be permanently effective, must be kept intact and in good condition at all times. Please issue instructions to your chief officer (assisted by the junior officers) to make a thorough inspection of the rat proofing in all cargo spaces upon the completion of outward discharge, all broken or displaced work to be put right before the loading of homeward cargo is commenced. An entry to the effect that this inspection has been made and all defects corrected, is to be made in the ship's log book.

You will also instruct the officer personnel detailed for the upkeep, inspection of rat-proof installation noted above to make careful observations throughout the vessel for evidence of rat life. If any evidence is found, such as nests, rat droppings, or rats, dead or alive, complete data covering same must be tabulated in duplicate, giving full particulars covering exact location in vessel, time and place found, together with the nature of the evidence, and a signed copy is to be handed to the quarantine officials in charge of rat proofing

[2] These two publications have been combined in this publication.—Ed.

at New York from our "round-the-world" service vessels, and quarantine officials at San Francisco from the San Francisco–Java–Calcutta line vessels, the other copy to be handed in at our New York and San Francisco offices, respectively.

The inspection of all rat-proof work in crew quarters, galleys, storerooms, pantries, messrooms, potato lockers, and all other spaces in and about the vessel not occupied by cargo is to be made on your periodic ship inspections, not less frequent than once a week.

In making out requisitions for any repairs that may be necessary to any part of the ship's structure that has been rat proofed, you will note in your requisition for the attention of our port superintendent, the necessity for inclusion in the specification a renewal of all rat-proofing installation that may be removed or in any way disturbed by such repairs or alterations as called for in your requisition.

STANLEY & JOHN THOMPSON, LTD.

SEPTEMBER 10, 1929.

Acknowledgments

The authors desire to express their thanks to the following named persons for valuable aid and suggestions: Mr. A. V. Bouillon, secretary of American Marine Standards Committee and the various members of the several technical committees of this committee; Mr. Robert Shaw, naval architect and draftsman; and to Messrs. T. X. Finnerty and L. G. McGuigan of the rat-proofing division, New York quarantine station.

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